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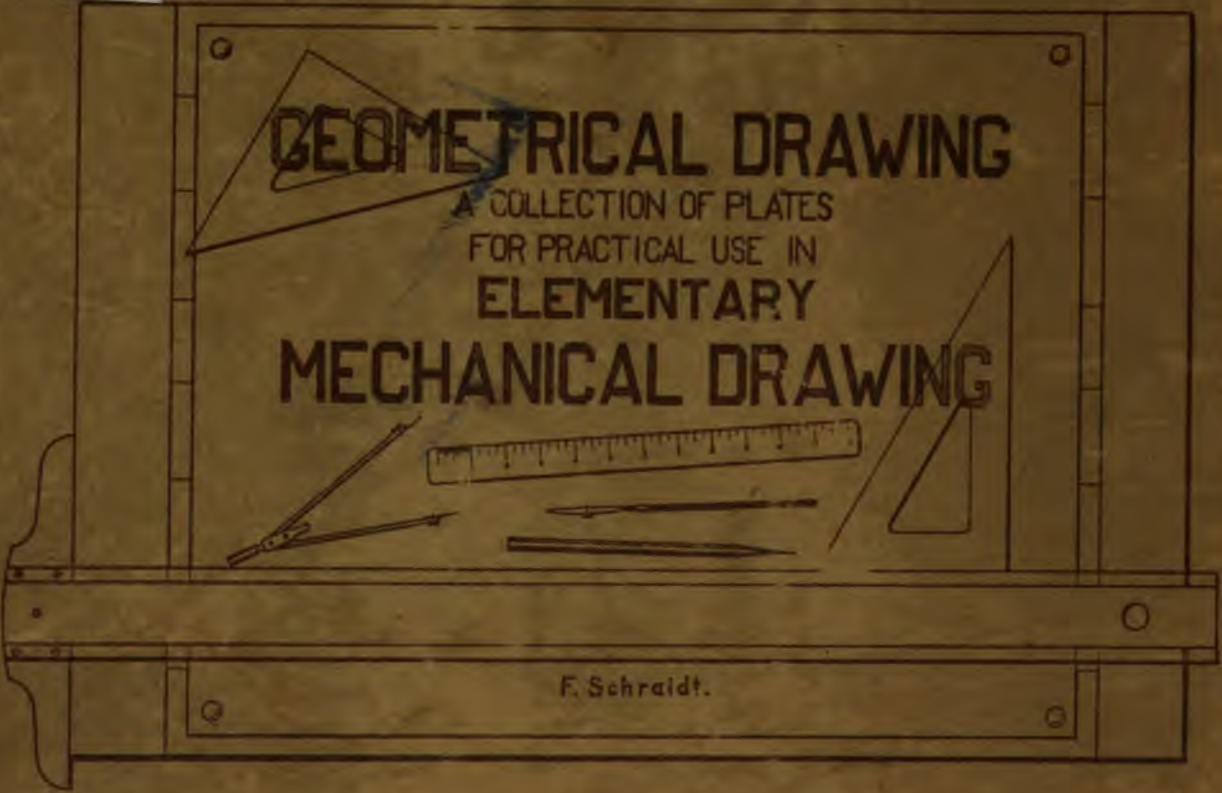

# GEOMETRICAL DRAWING

A COLLECTION OF PLATES
FOR PRACTICAL USE IN

# ELEMENTARY MECHANICAL DRAWING

F. Schraidt.

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Berkeley, Sept. 15.

# GEOMETRICAL DRAWING

A Collection of Plates for Practical Use in

## ELEMENTARY MECHANICAL DRAWING

BY
F. SCHRAIDT, M. A.
Head of the Department of Drawing, Oakland High School
OAKLAND, CALIFORNIA

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# INTRODUCTION

Geometrical Drawing (Elementary Mechanical Drawing) as a school subject comprises a two-fold purpose: a pedagogical and a purely practical one. A pedagogical benefit lies in the training in regard to the pupil's accuracy and definiteness. The object is not merely to represent geometrical figures by a set of lines, but these lines must be closely observed, accurately measured and definitely placed. This feature of discipline must always be kept in mind. The plate of Geometrical Drawing is also to develop an active sense for symmetry and harmony; the different figures and problems should be placed so as to balance the whole outline. The general impression of the finished drawing should be one of neatness, expressed in line-work and lettering, and of cleanliness.

While this purely pedagogical benefit is always evident, Geometrical Drawing is particularly valuable as Elementary Mechanical Drawing for vocational work, be it for mechanical or structural or architectural engineering. Not only that Geometry and the "French" Curve as such form a necessary schooling for the professional draftsman and engineer, but the student becomes acquainted in this work with his mechanical appliances, as scale, T-square, triangles, compass, ruling pen, brush, etc. and learns their proper use. With this knowledge he is prepared to handle more difficult problems of drawing since he has previously acquired a critical eye and a trained hand.

Here it should be remembered, that the nature of this preparatory drawing in regard to the choice of its problems is not so important as the exactness in the line-work itself. A student, who has acquired a sense for accuracy and habitual neatness is well prepared for his professional work because he has learned the one important prerequisite, namely: how to make any drawing intelligent and reliable.

# LIST OF DRAWING EQUIPMENT

## (A SUGGESTION)

1. One Drawing Board, about 16" x 22".
2. One 24" T-Square, maple blade, walnut fixed head.
   or Transparent Edges.
3. One 30° Triangle, about 10", Transparent.
4. One 45° Triangle, about 8", Transparent.
5. One Triangular Boxwood Architect Scale, 12".
6. One Set of Instruments, consisting of
   - One 6" Compass with Pen and Pencil Attachment.
   - One 6" Dividers.
   - One 3½" Pen Bow.
   - One 5" Ruling Pen.
7. Two Sheets of Cream colored Drawing Paper, 27" x 40".

   This size of paper will furnish 4 plates each. If good quality ("Duplex" or "Corona") is selected, it will take ink well, while its cream color does not strain the eye as much as the glaring white.
8. One A. W. Faber Drawing Pencil, ~~3H.~~ 4 5H or 4H
9. One Pencil Eraser, E. Faber No. 111, green; One Sponge Eraser.
10. Two Bottles Waterproof Drawing Ink, black and red.
11. One Dozen thin edge Thumbtacks, ⅜" diam. or less.
12. One Penholder with Pens: Esterbrook & Co. Interstate, No. 815.
13. One Transparent "French Curve."

NOTE.—It is suggested, that no Ink Eraser or Knife be used for corrections in ink. The green Pencil Eraser with the application of a little powdered Pumice will do neater work.

Equipment not available in local stores can be ordered from the publishers.

# EXPLANATORY NOTES

The following sixty-five pages represent a set of sixty practical plates for Geometrical or Elementary Mechanical Drawing for Secondary and Primary Schools. From these the instructor or student is to select a number of plates according to requirement or taste. A set of twenty-five plates is suggested as equivalent to a school year's work with one daily period or forty-five minutes, or to half a year's work with double periods daily. The consecutive number of each chosen plate may be inserted in the space provided for.

The size of each plate which the student is to make from the small sample drawing, is assumed to be 12" x 17", and good cream colored or white drawing paper should be used; the margin, represented by a heavy line, allows a space of one inch on each side. Each sample plate in this book has been furnished with dimensions measuring from the margin line, which will place the problems well on the sheet. The student observes, how a drawing might properly be provided with dimensions; yet, he is asked to omit the same from his plate, since this is a feature of Mechanical Drawing proper and not included in the present course.

The sample plates are drawn "to scale," but at a reduced size; therefore the student will find it impossible, simply to measure off from the sample any dimension with the dividers. In case a dimension should not readily be found on the plate, the student will have to compute or to calculate by proportion the desired length.

A possible objection, that the student is merely "copying" a plate is not justified; he is reproducing a drawing of his own, using a good and correct sample, and since "Mechanical" Drawing requires a number of mechanical tools and skill in using them, it might well be said, that in the elementary work of this sort emphasis be laid on the acquaintance with these tools and with their possibilities. The process of making a Mechanical Drawing in regard to forming a habit of good line work must become an unconscious, a mechanical one by repeated practice, before the student can pay all attention to advanced problems of design and construction.

Neat lettering should receive special attention, and each plate should be valued in regard to careful lettering as well as to its line work; special "lettering plates," a practice in Freehand printing, should be made from time to time.

It is essential for the development of carefulness and skill to use ink after the plate has been completed in pencil; waterproof black ink is recommended for the heavy lines, and red ink for the fine construction lines. If a variety of colored inks is preferred, there should be a uniform system carried on throughout the whole course.

Individual taste can well be taken into consideration, and changes on the suggested plates be made accordingly.

Explanation of signs: R=Radius; ∠=Angle; ||=Parallel; ⊥=Vertical.

Pages 1, 2, 3, and 4 offer exercises in simple line work with the T-square and both triangles.

Page 5 condenses the practice of several previous pages into one plate.

Pages 6 and 7 contain simple straight line designs, which might also be used for practice in flat tinting.

Page 8 shows block letters, filled in with black ink; but any water color could be used instead.

Pages 9, 10, 11, 12, 13, 14, 15, 16, and 17 introduce the use of the compass, circles alone or in connection with straight lines.

Pages 18, 19, 20, 21, 22, and 23 deal with problems of Geometry.

Page 18: Each Radius (R) on this page is arbitrary in length. Line A-B of the fourth problem is drawn at any angle and of any length; beginning at A, seven equal parts of any size are measured off on this line; the last point is connected with C, and parallel lines to this drawn through each point towards A.

Page 19: In order to solve the sixth problem, A-B is bisected in C, an arc is drawn to E with R=C-D, and another arc with R=D-E to find F. D-F is equal to one side of the Pentagon.

Page 21: In the first problem bisect P-C in A; draw a circle with A as center and a Radius=A-C and mark the points of intersection with the given circle. Connecting P with these points will furnish the tangents.

In the second problem bisect A-B in C; the arc with A-C as Radius intersects the arcs with Radius of B plus or minus Radius of A in point D. A parallel line to A-D at a distance equal to Radius of A will locate the two points of tangency.

In the third problem draw arcs around A with a Radius=R of A plus R of C and around B with a Radius= R of B plus R of C, and find center for C at intersection.

Problems four and five are solved by adding to or subtracting from line P-C the Radius of B. The bisecting perpendicular of P-B will meet the production of P-C in D, the center for the required circle.

In the sixth problem draw arcs with R=A-C as shown, connect D with C, which intersects the perpendicular of A-C in E; measure off the distance of A-C, beginning in E, three times and find H. H-B is equal to one-half of the circumference.

Page 24 contains simple circle designs, applying problem four on page 18 and problem six on page 19.

Pages 25, 26, 27, and 28 show different designs for flat tinting in one or in different colors. Only first-class water colors and good brushes should be used. The sections of Standard Profile Steel on page 28 are taken from the catalog of Jones & Laughlin, Steel Company, Pittsburg. The pounds (℔) indicated, refer to weight of steel per foot.

Page 29 includes compass curves and an exercise in "French" curves.

Pages 30 and 31, showing the Spiral, Involute, and Volute, are drawn with the compass. The Spiral on the right side of page 30, however, is also drawn with the "French" curve. The Involute is obtained by drawing arcs with Radii from 1, 2, 3, 4, etc., on the circumference of the given circle, to the tangent of each corresponding point. The Involute is applied in Gearing; the Volute is an architectural ornament.

Pages 32, 33, and 34, showing curves formed by straight lines, are suggested as introduction to the curves proper.

Page 35 presents methods to obtain a Parabola and a Hyperbola.

Pages 36, 37, and 38 are devoted to the Ellipse. The "Trammel," cut out from paper, on page 36 moves with its two given points on C-D and A-B respectively, thus outlining at its outer end the Ellipse. The "Focus" of the Ellipse on page 38 is found by an arc with a Radius= one-half of the Major Axis. With one Focus as center and any Radius larger than the distance from the Focus to the nearest end of the Major Axis (in this case 1" has been chosen) draw an arc; with the other Focus as center and a Radius=Major Axis minus the chosen Radius of the first arc (1") draw another arc; both arcs will interect and locate two points for the Ellipse; repeat this process any number of times with new dimensions. The second problem on page 38 is suggested as an example for drawing a Circle in Isometric Projection, where it becomes an Ellipse. Draw Square within Circle first, then 30° line with divisions as shown. The distance marked X is obtained with the divider from the circle construction and measured down from the 30° line for the Ellipse.

Pages 39, 40, and 41 contain the three Conic Sections, which will produce the Hyperbola, the Parabola, and the Ellipse. The angles of 45° and 60° have been chosen for the sake of convenience and do not necessarily have to be of this size.

Pages 42, 43, 44, and 45 show examples of the Cycloid, the Epicycloid; and the Hypocycloid. These curves are traces of a point on a circle rolling on a straight line or on another circle. The equal distances marked 1, 2, 3, 4, etc., on the given circle, which is drawn first, are measured off from both sides of its center line on the straight line or the circle, on which the first circle is to roll.

Cycloids are frequently used in Gearing.

Page 46 represents the Helix, a curve, which resembles the path of a point uniformly moving around on the circumference of a cylinder and at the same time on the surface of the cylinder along a line parallel to its axis. The vertical distance, which is the point has moved along this line, is called the "Pitch"; Pitch and circumference of the Cylinder must always be drawn first to determine the points of construction for the Helix, and both are divided into the same number of equal parts. In order to save space, only one-half of the circumference of the Cylinder is shown in each case.

Pages 47 and 48 give examples of the Helix as a curve of different screw-threads. The very ends at the turn of each curve are best drawn with a compass, being too small for the "French" curves.

Page 49 shows a symmetrical arrangement of "French" curves.

Page 50 gives the construction of a truly Egg shaped Oval.

Pages 51 and 52 submit a practical application of the Ellipse with a Major Axis of 29 and a Minor Axis of 18 feet. This Ellipse should be constructed first followed by the 23" divisions, beginning at each end of the curve towards the middle, and tangent to an arc drawn at each division point with a Radius of 24" is drawn the second and outer Ellipse. The slanting lines—between these two curves—are drawn from the point of tangency to the division point on the inner Ellipse. Note the use of a Scale: ⅜"=1 foot, which will be found on each triangular Architect's Scale.

Pages 53 and 54 are dealing with problems to locate the path of motion of a point, which will be found to travel on an irregular curve, returning to its starting point.

Page 55 shows examples in Shading. Note that with a darker tone of shadow the shading lines become narrower and heavier.

Page 56 contains in outlines three important cases of Projection. Since this topic is treated largely in the second part of this work called "Descriptive Geometry," no further details or applications are given here.

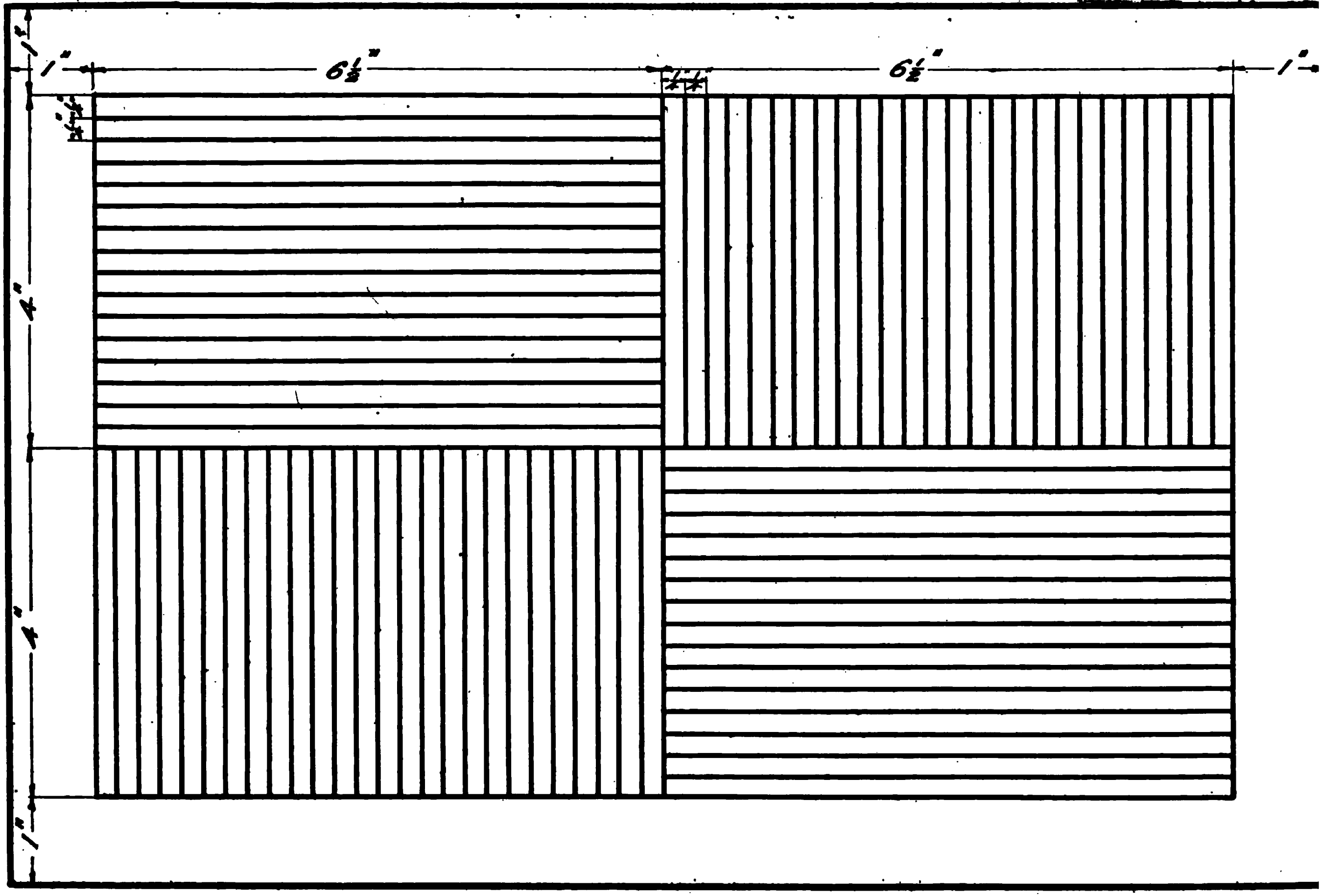
Pages 57, 58, 59, 60, 61 and 62 give three samples of Gothic design. The sheets showing the construction method in each case, will furnish sufficient explanation.

Page 63 shows a Balustrade with an application of plain surface shading. Note the Scale: 1½"=1 Foot, found on the triangular Architect's Scale.

Pages 64 and 65 suggest an alphabet of shaded letters. Instead of the black shadow each letter might receive a light coat of water-color and the shaded part of it be painted in a darker tone of the same color.

Page 66 contains some geometrical data, which might be convenient when computing various dimensions for geometrical figures.

PLATE ☐



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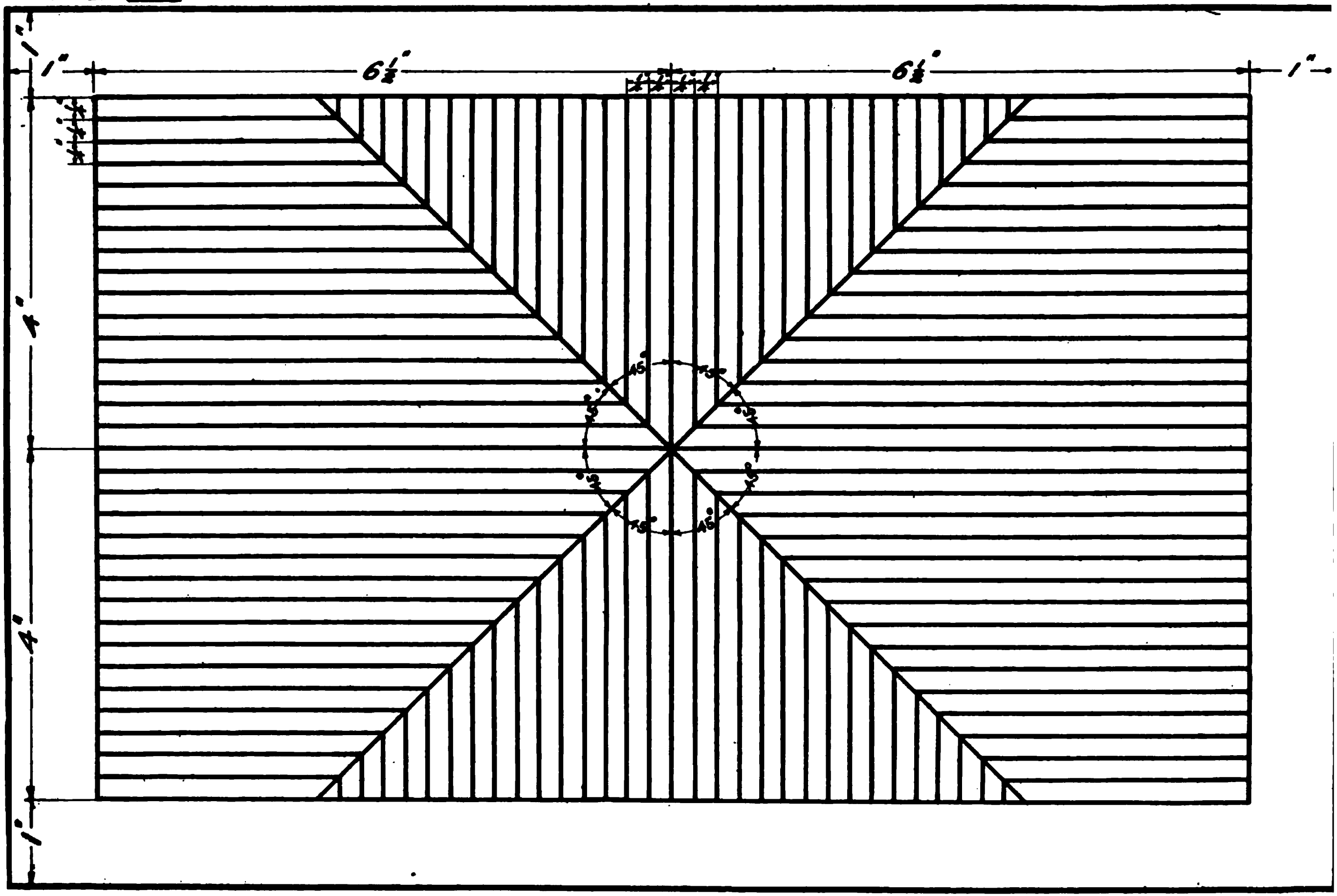
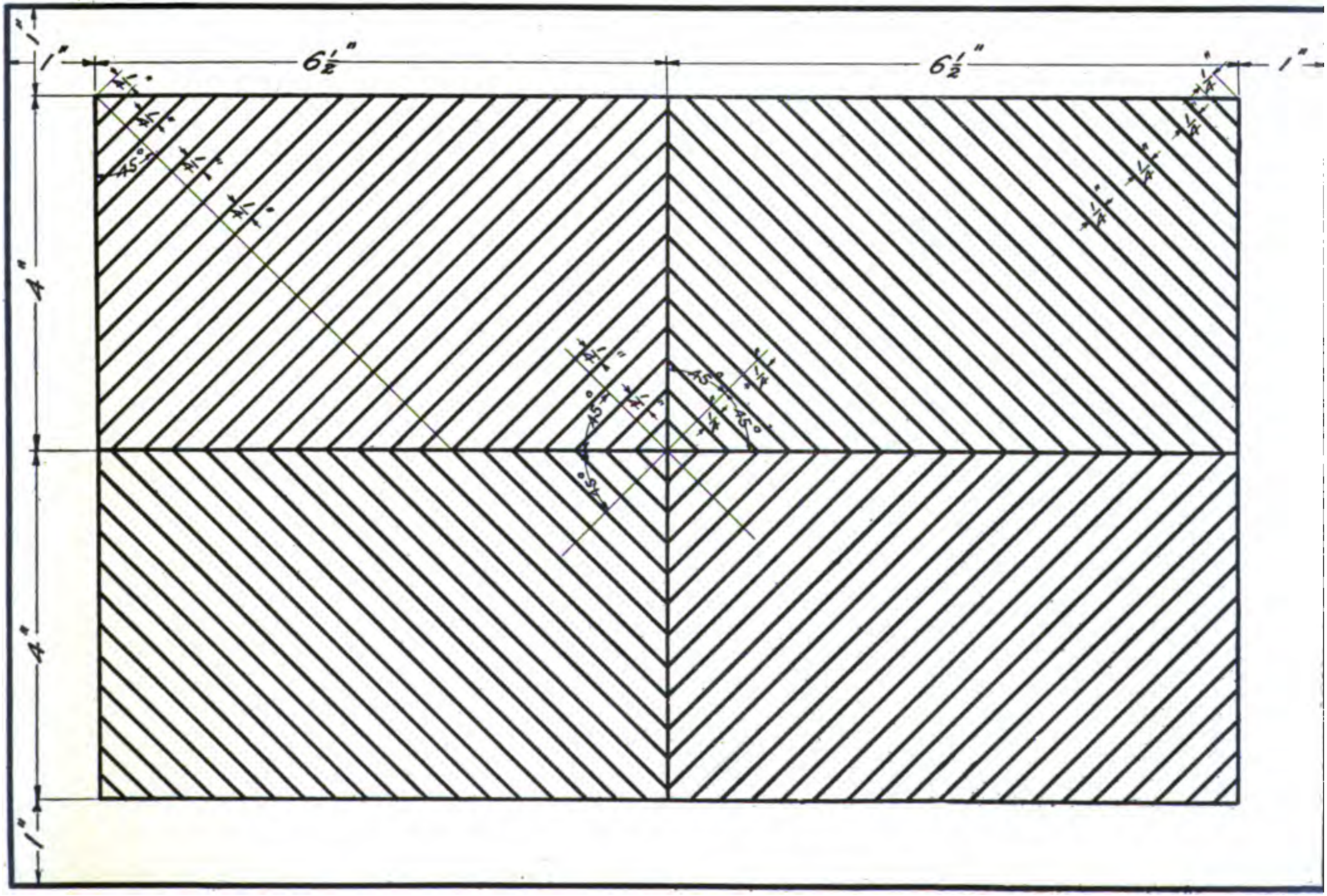


*Note: Omit all dimensions.*

PLATE ☐



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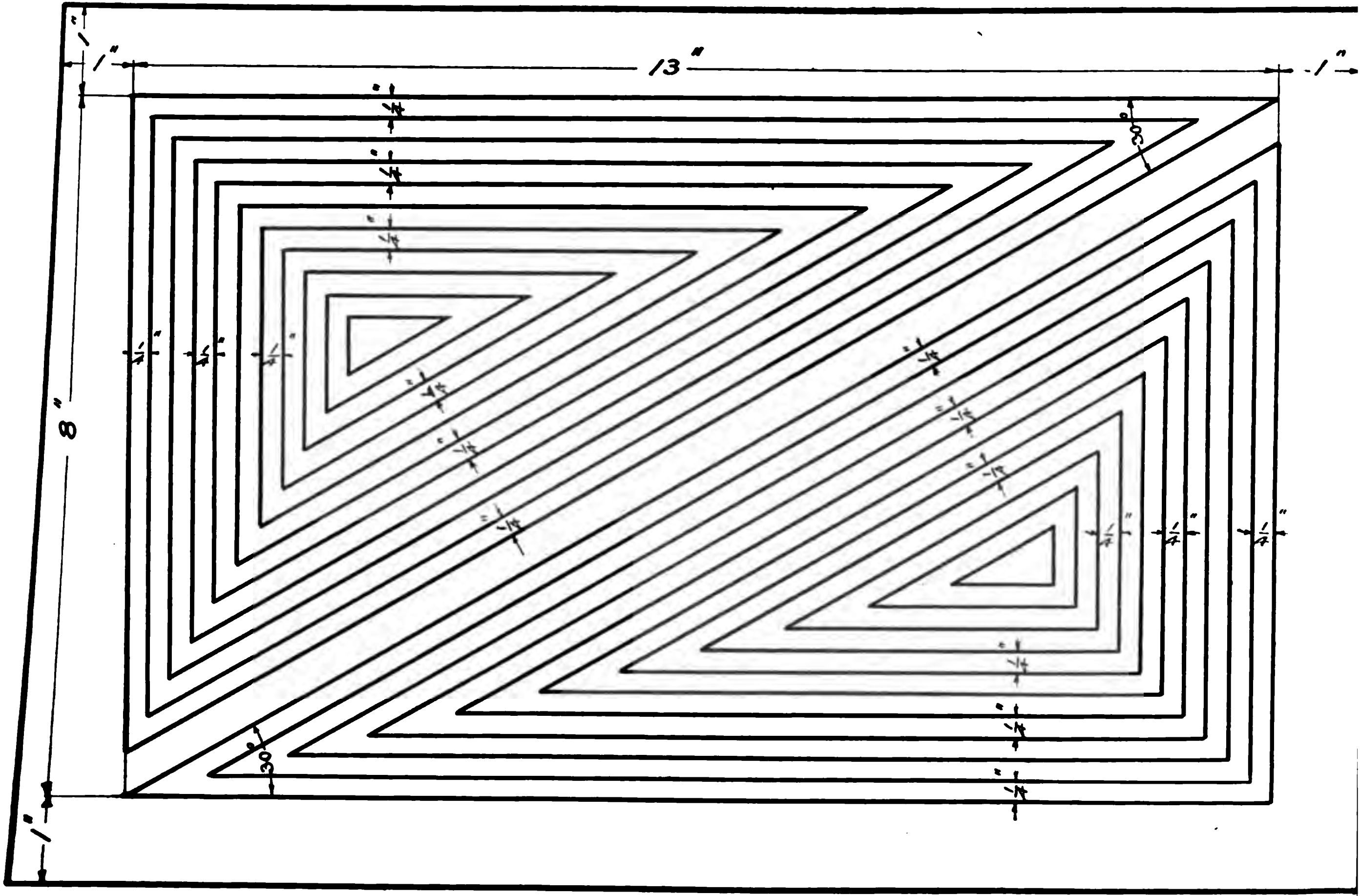

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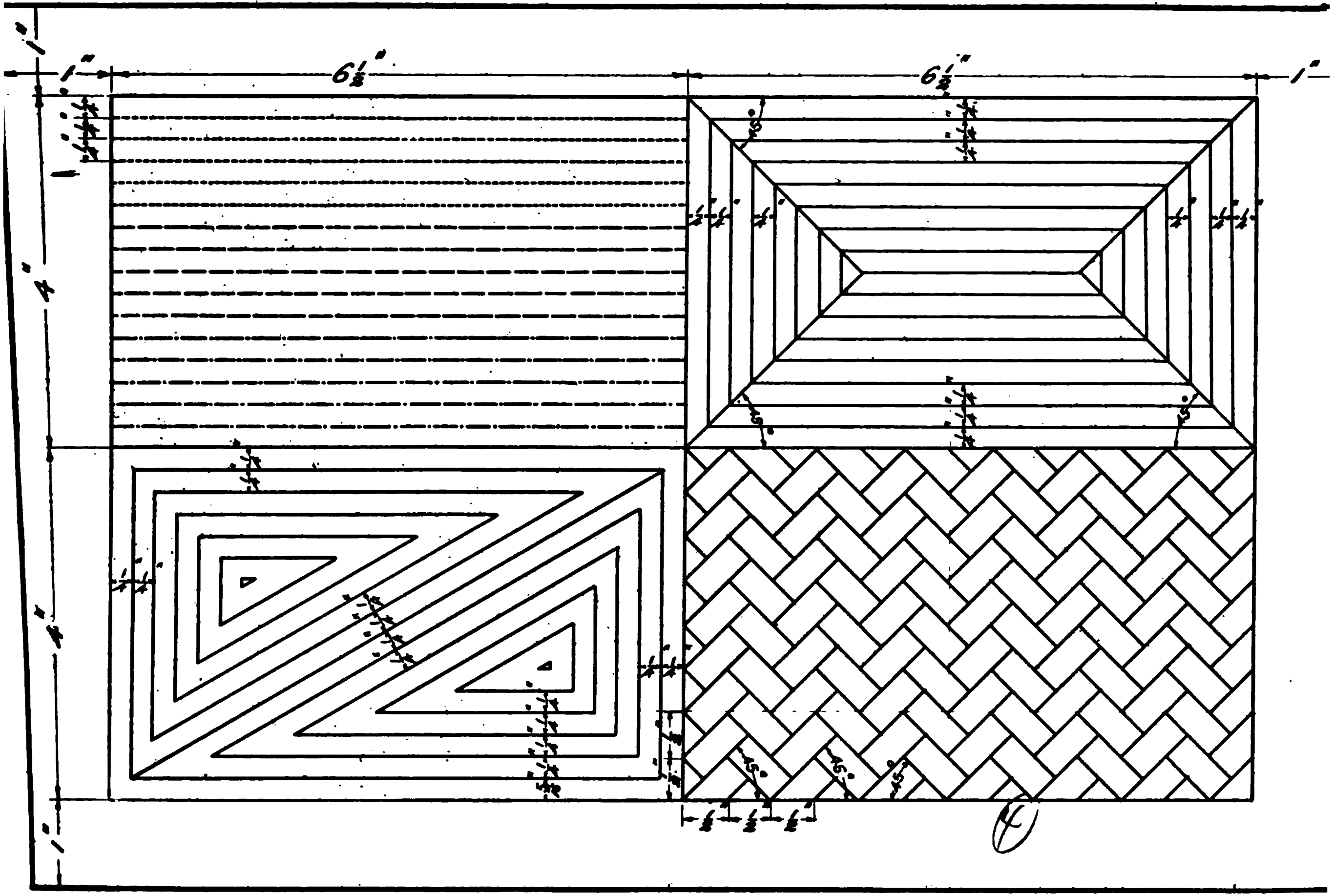

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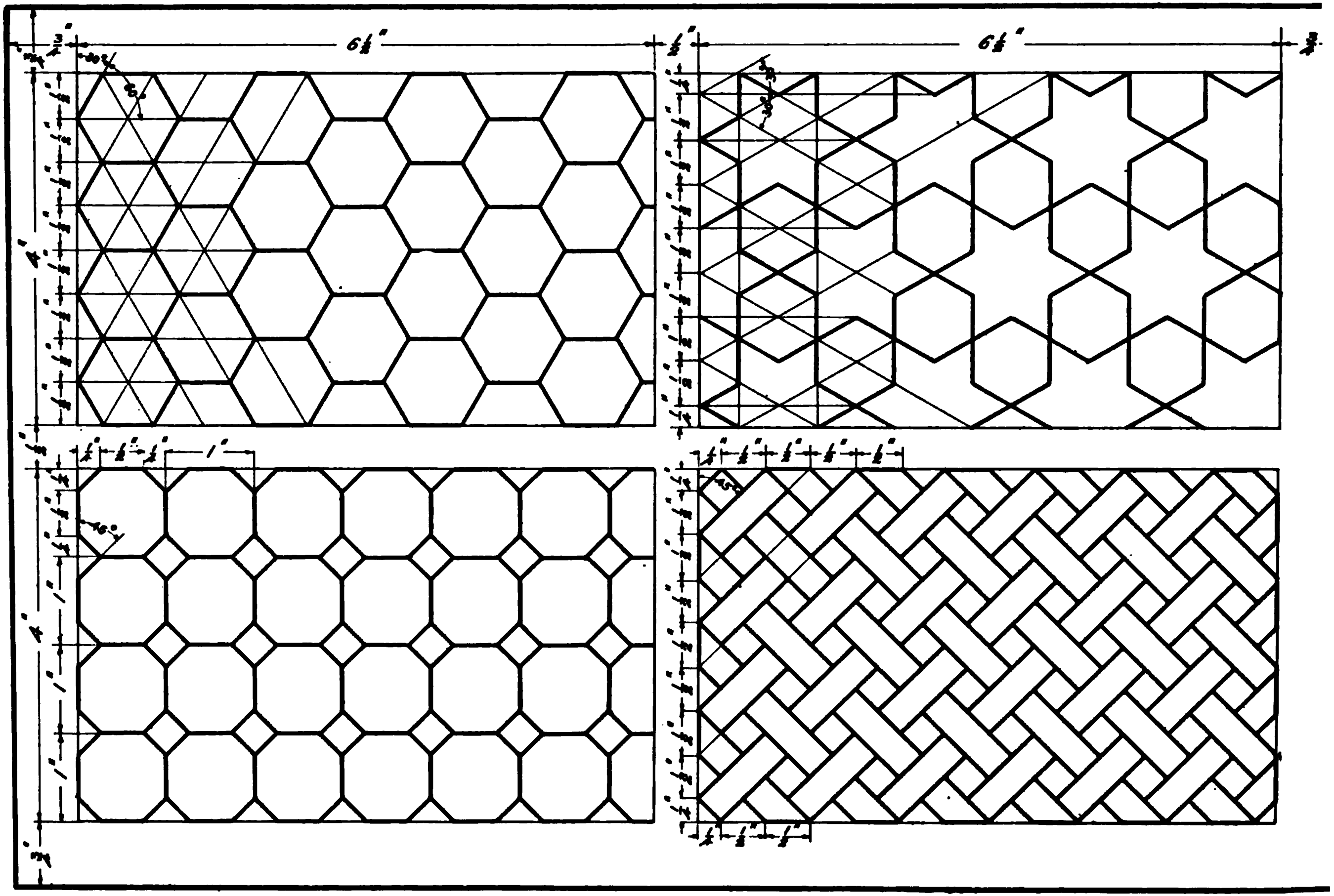
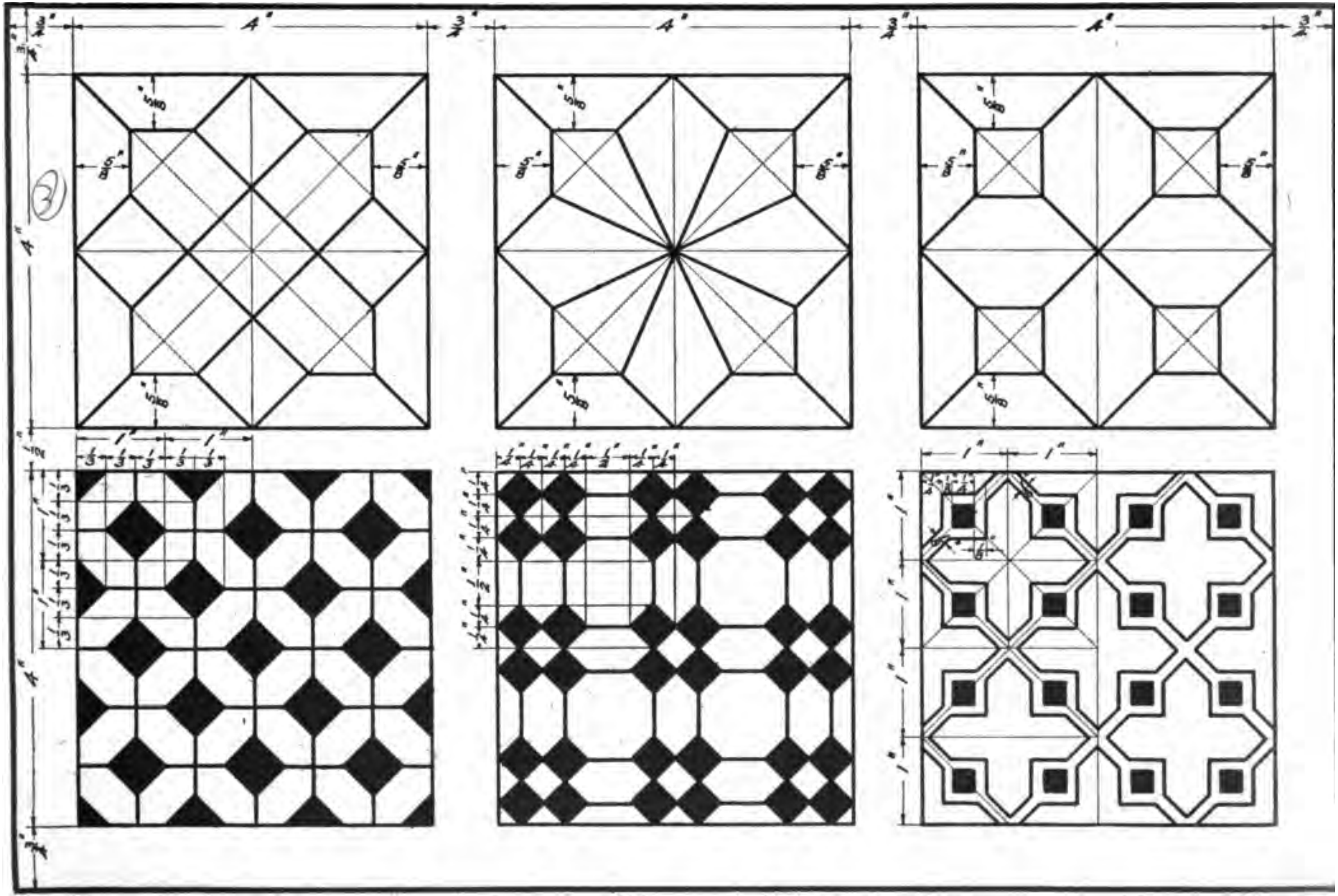


*Note: Omit dimensions and construction lines*

PLATE ☐



***Note: Omit dimensions and construction lines.***

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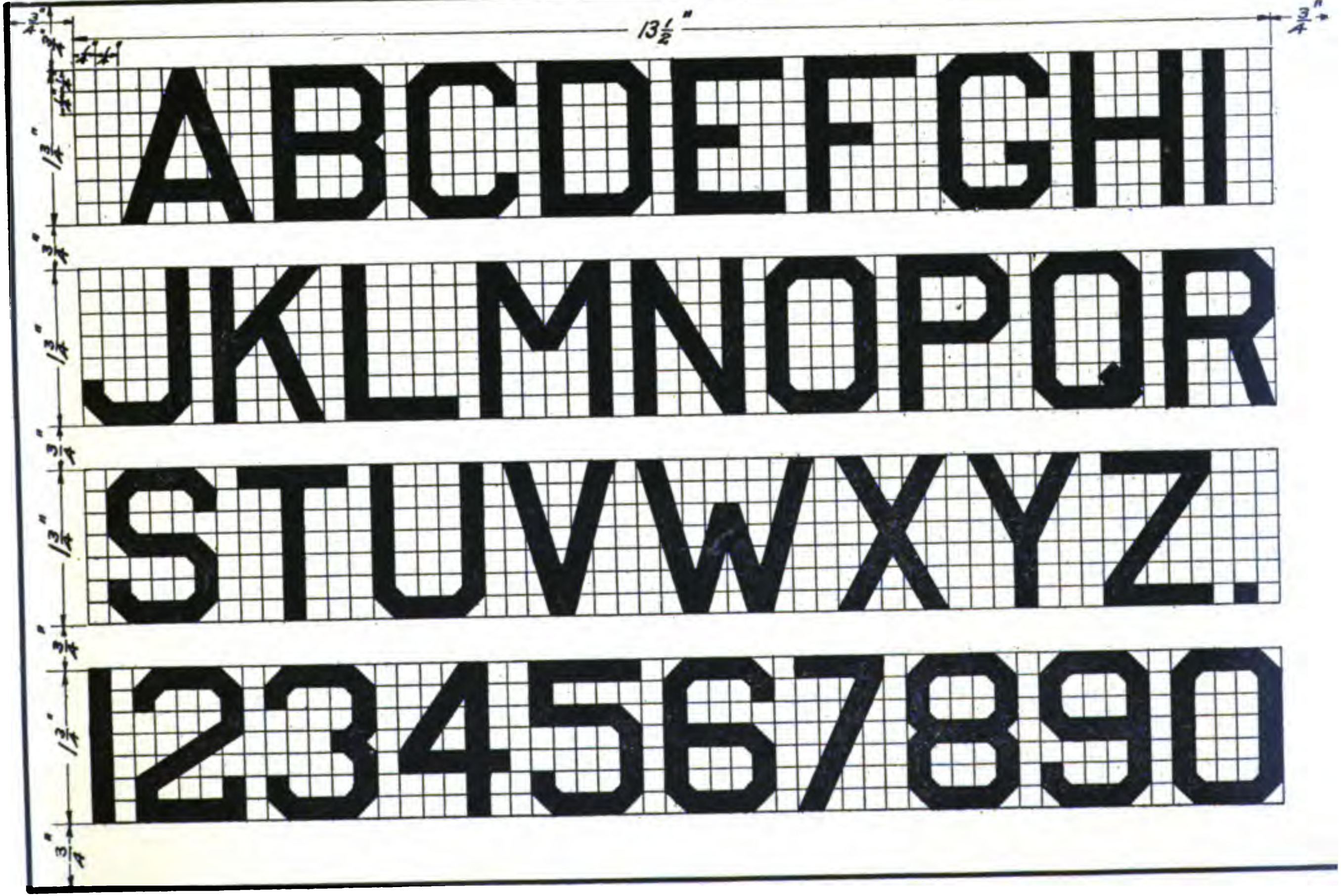

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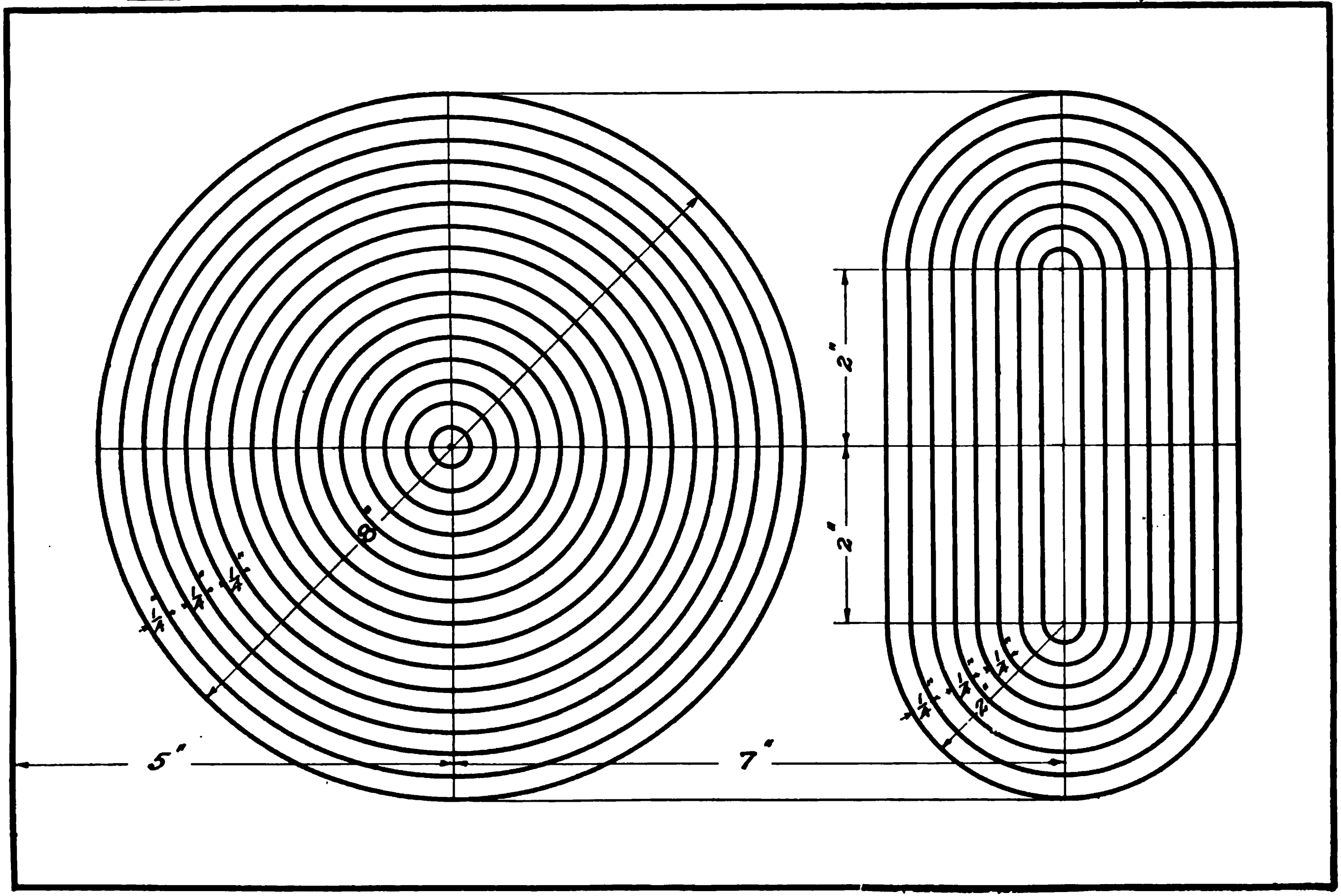

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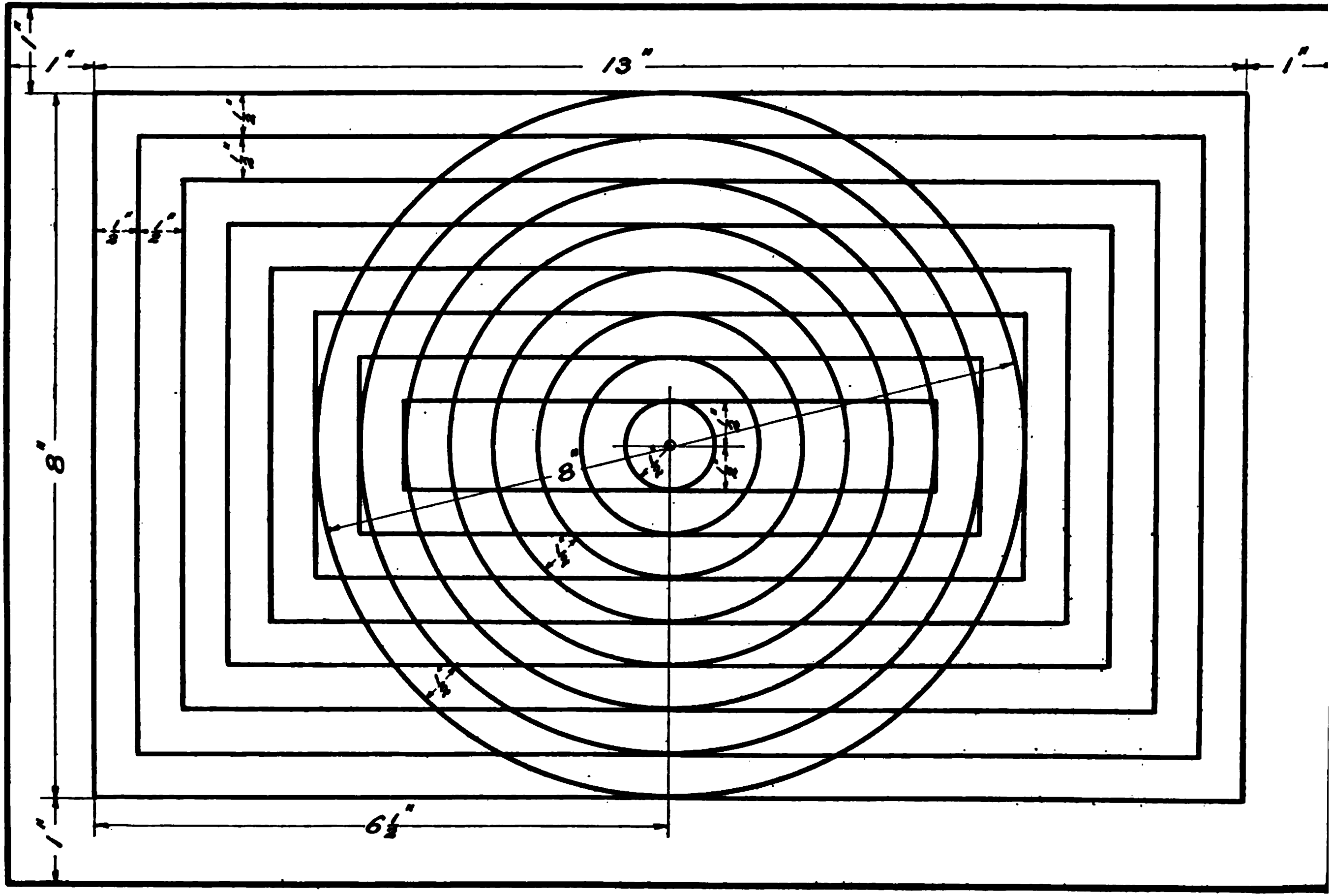

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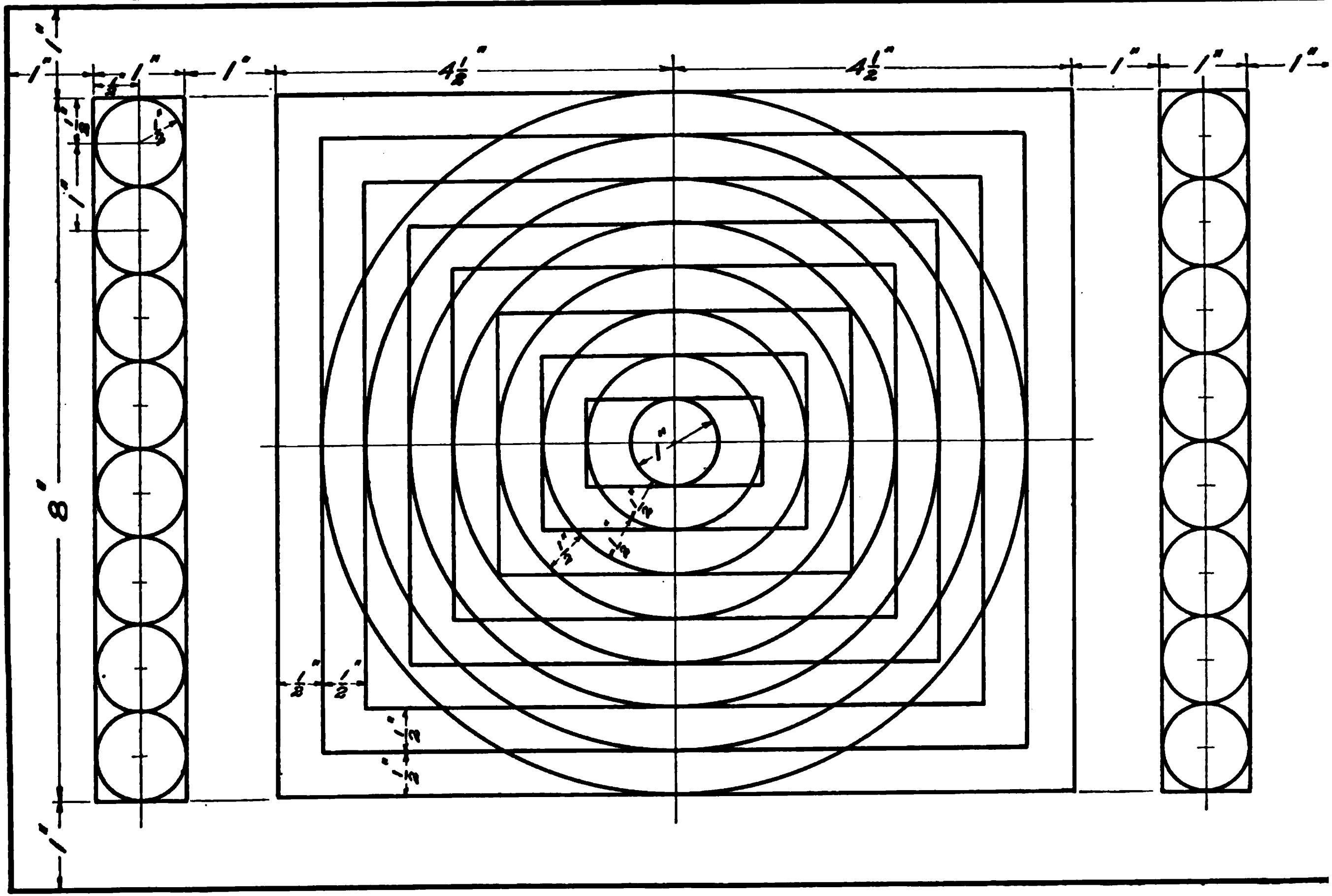

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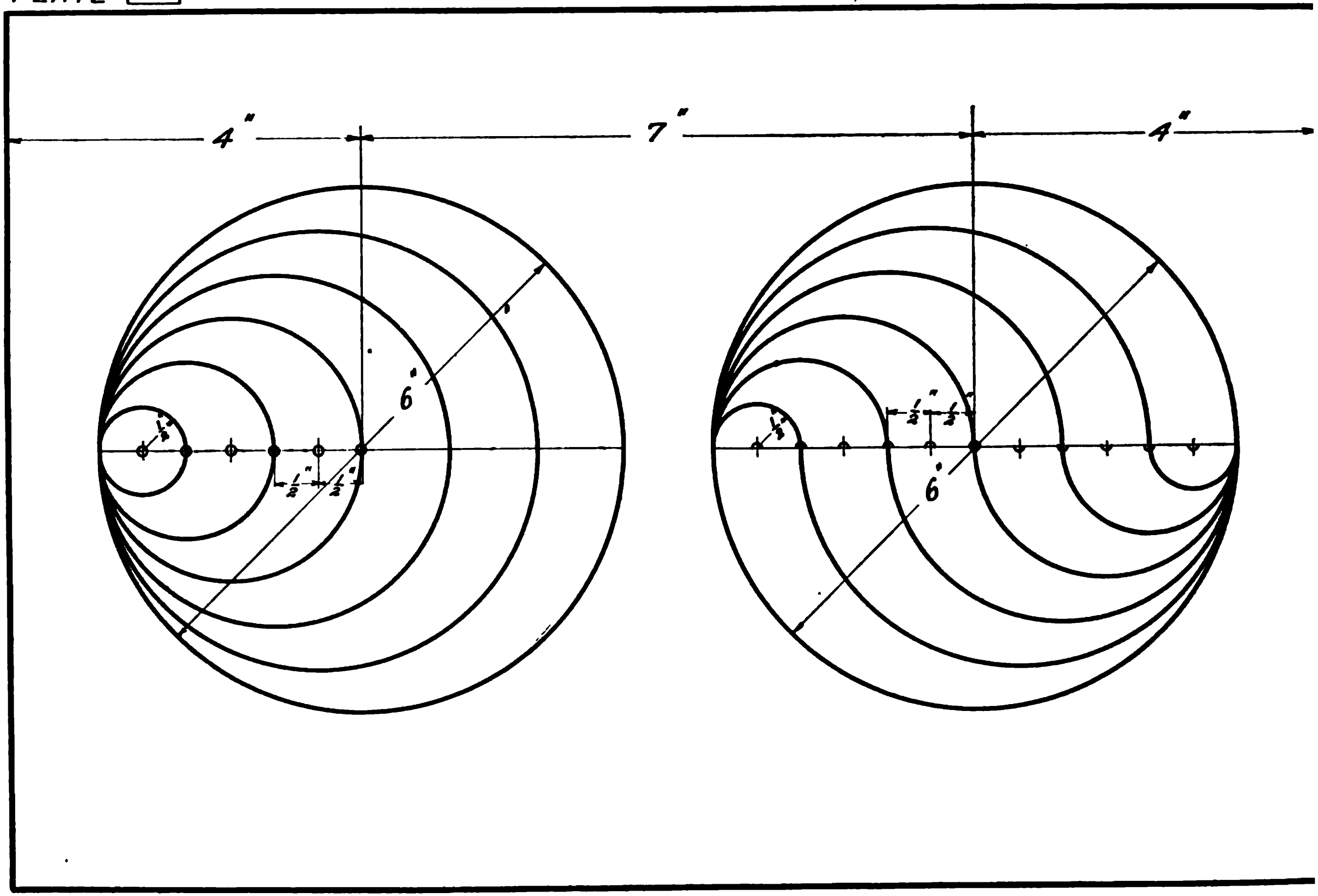
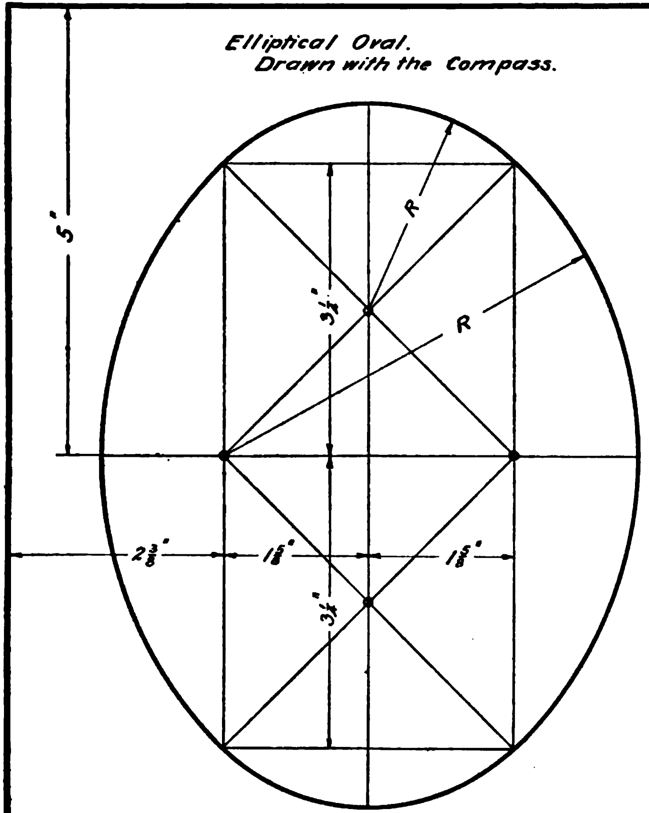
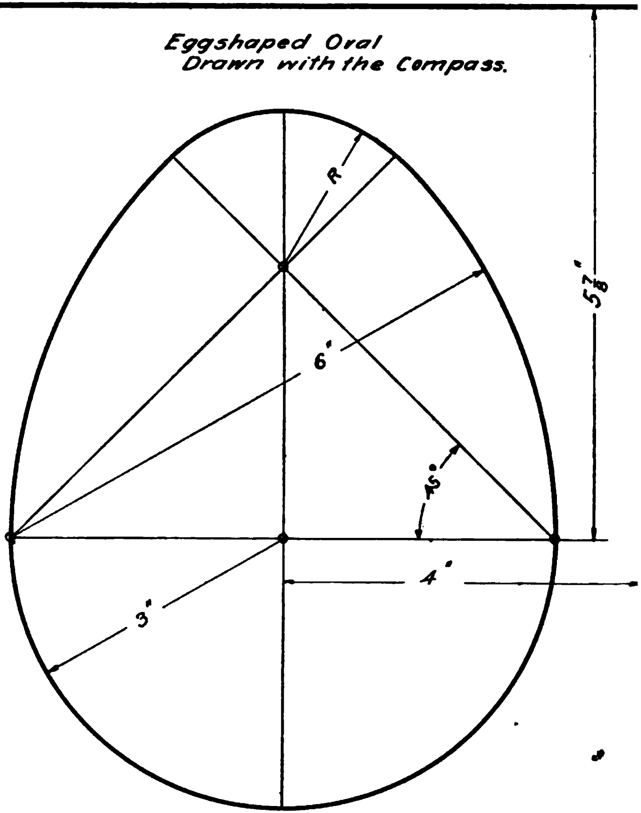


*Note: Omit all dimensions*

Elliptical Oval.
Drawn with the Compass.

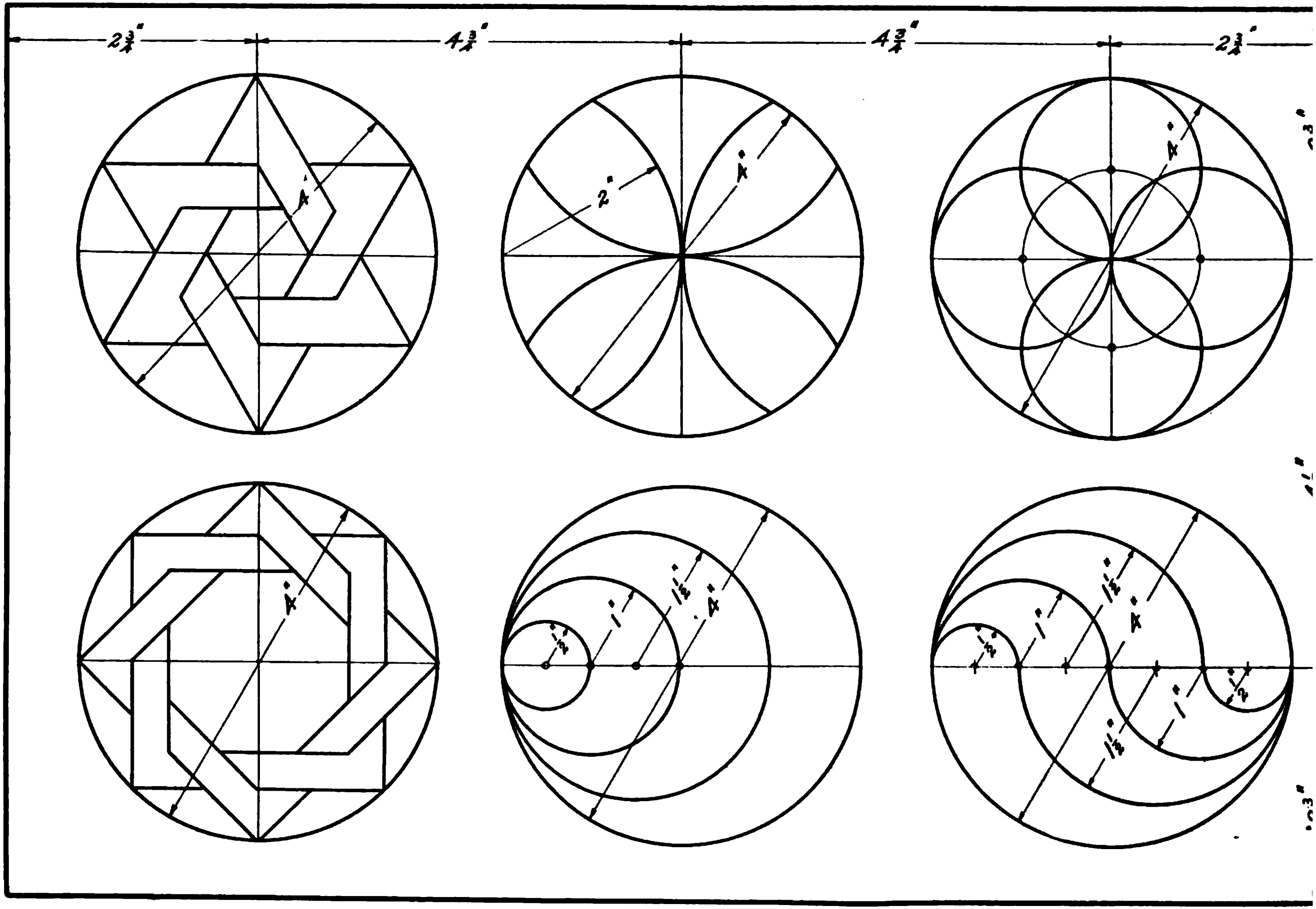


Eggshaped Oval
Drawn with the Compass.



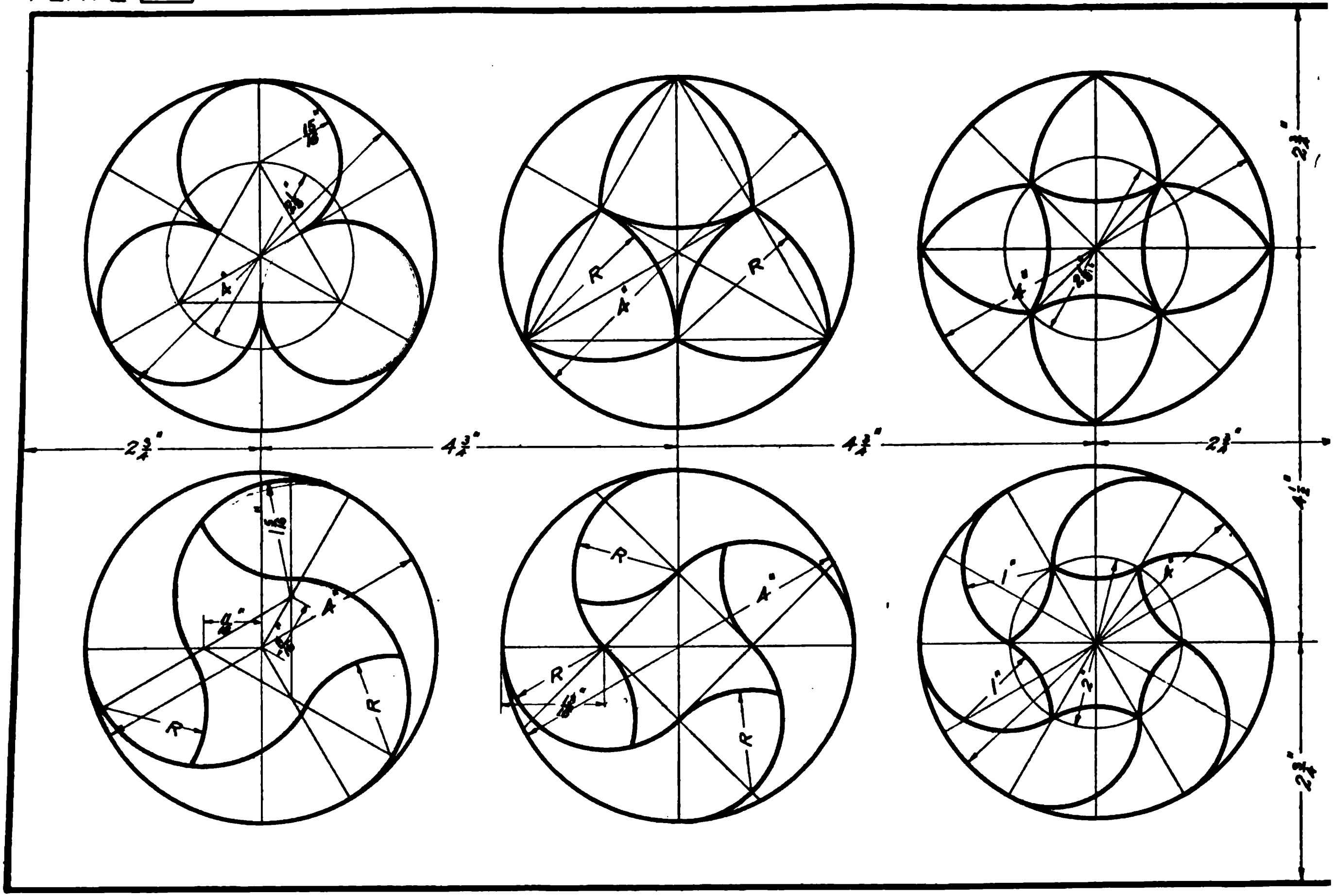
Note: Omit dimensions, but provide construction in fine red lines

PLATE



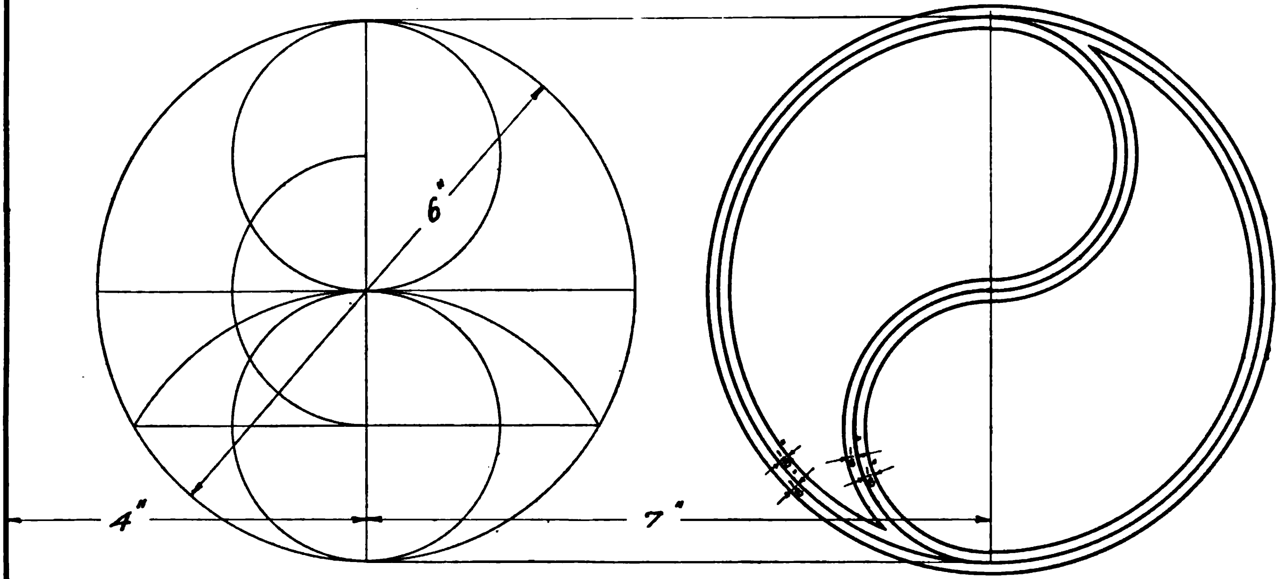
*Note: Omit dimensions and construction lines*

PLATE ☐



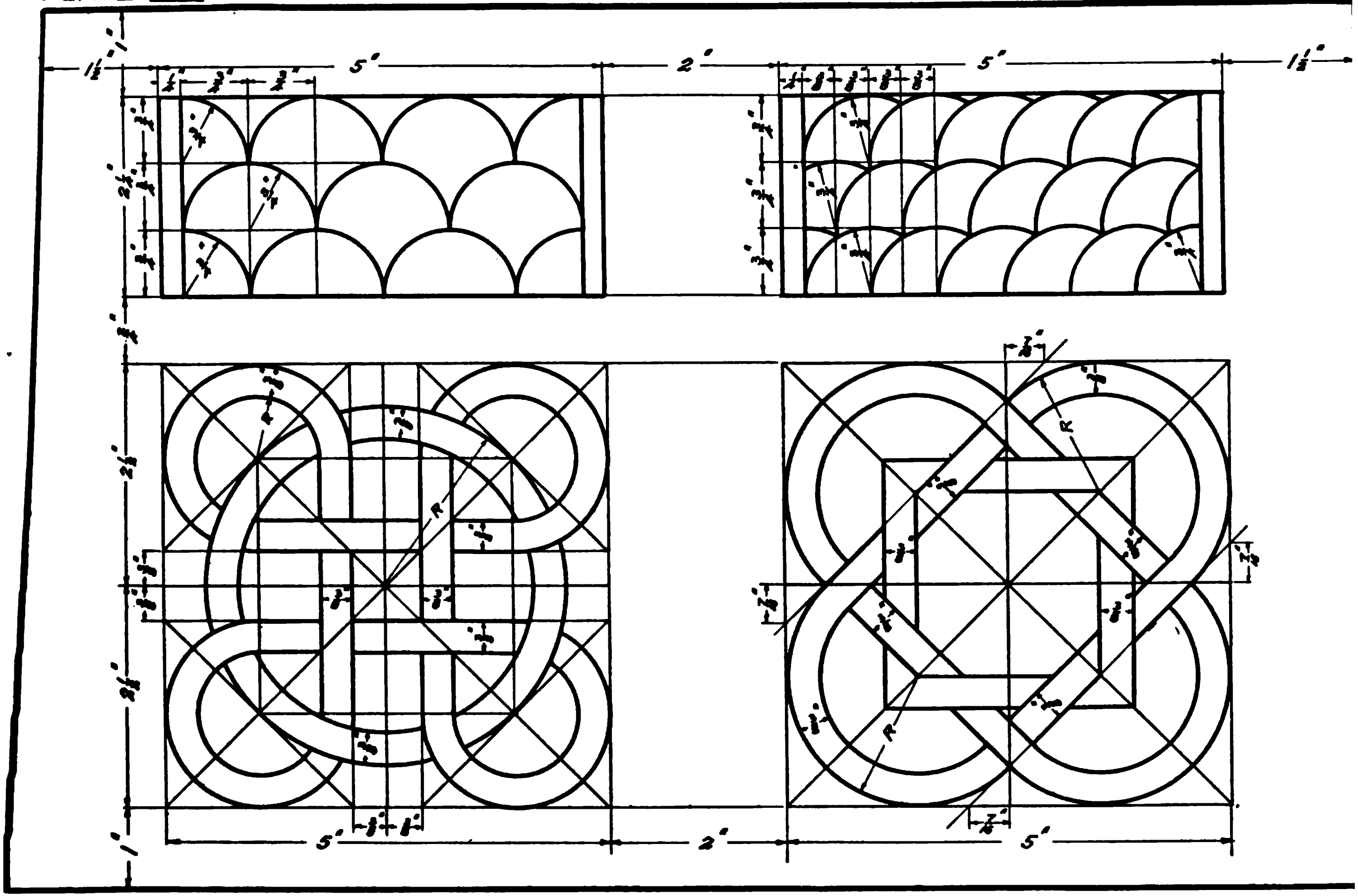
*Note: Omit dimensions, but provide construction in fine red lines.*

PLATE

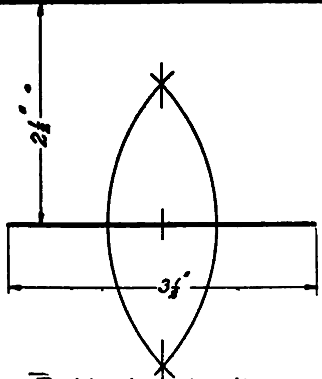


*Note: Show construction in fine lines on left side of plate as above; omit dimensions.*

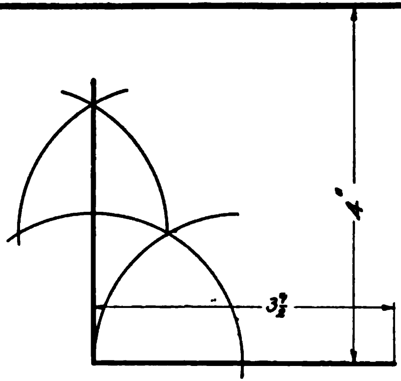
PLATE ☐



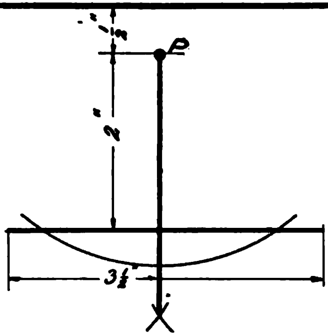
Note: Omit dimensions and construction lines.



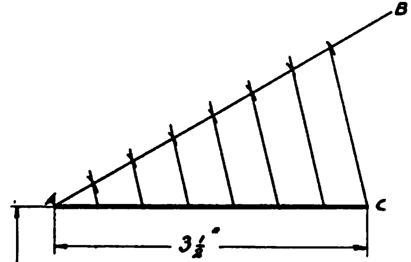
To bisect a given line



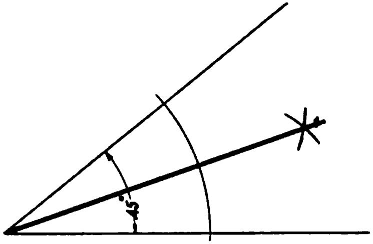
To draw a perpendicular at the end of a given line.



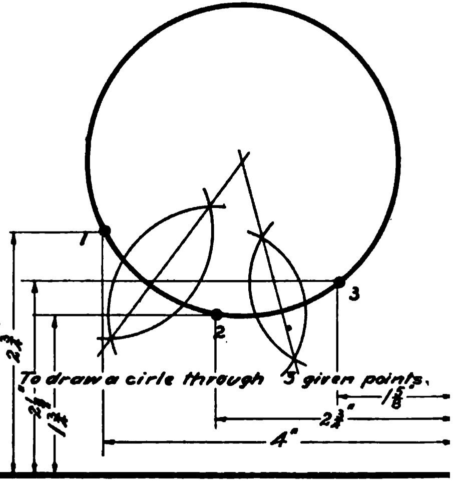
To draw a perpendicular to a given line from a point P



To divide a given line into any number of equal parts.



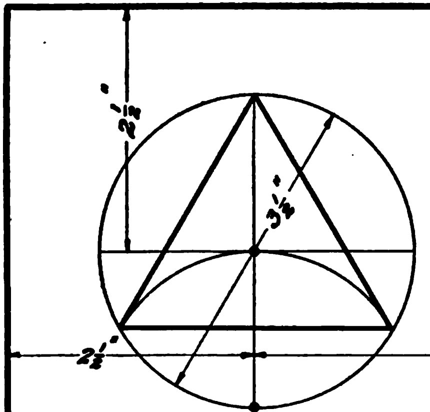
To bisect a given angle.



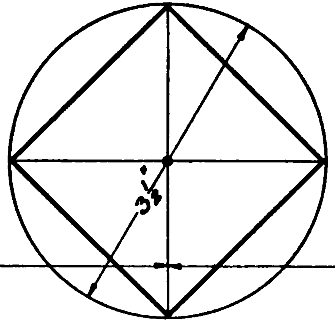
To draw a cirle through 3 given points.

Note: Provide all printing as shown above, but omit dimensions.

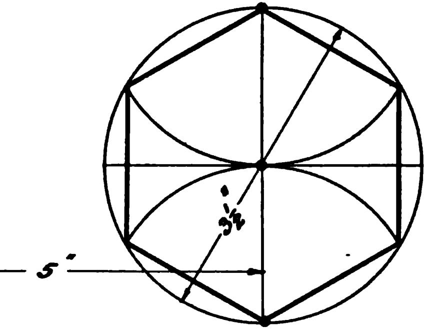
PLATE



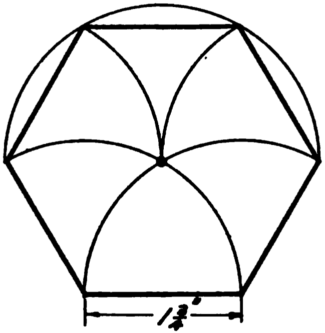
To inscribe an equilateral triangle within a given circle.



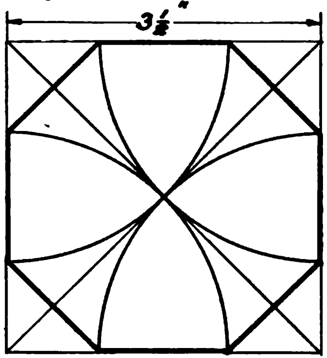
To inscribe a square within a given circle.



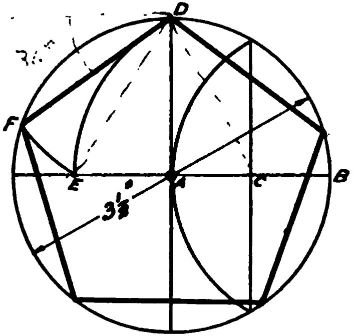
To inscribe a hexagon within a given circle.



To construct a hexagon on a given line.



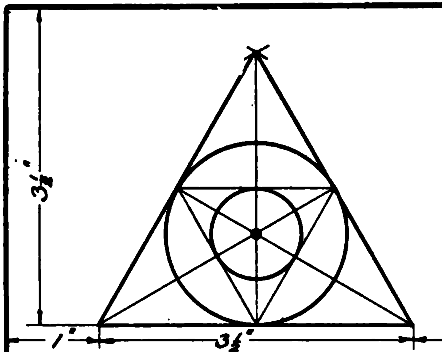
To construct an octagon within a given square.



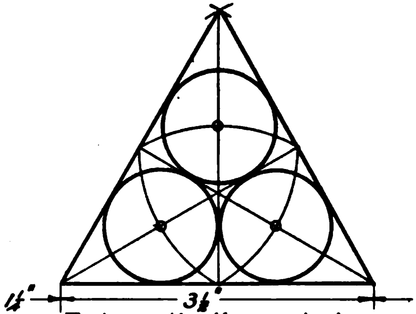
To inscribe a pentagon within a given circle.

Note: Omit all dimensions, but provide printing; small letters to be ⅛" high.

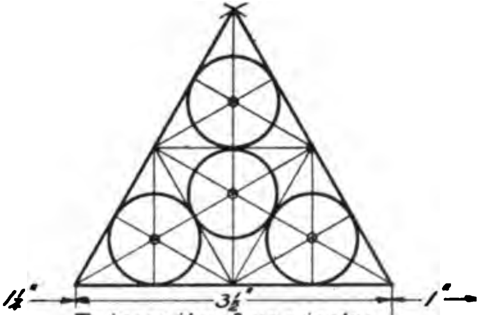
PLATE ☐



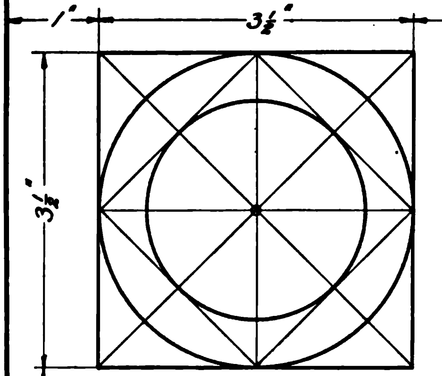
To inscribe a circle within an equilateral triangle.



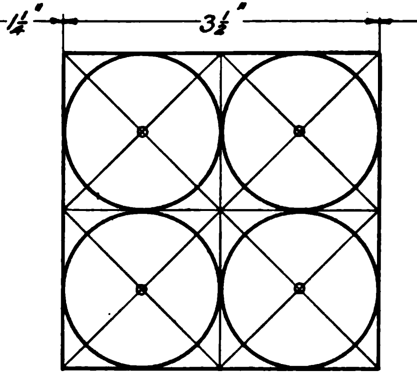
To inscribe three circles within an equilateral triangle.



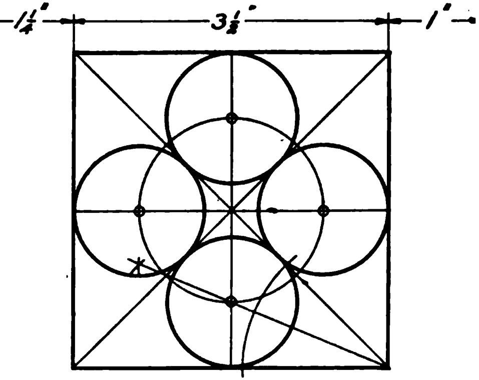
To inscribe four circles within an equilateral triangle



To inscribe a circle within a given square.



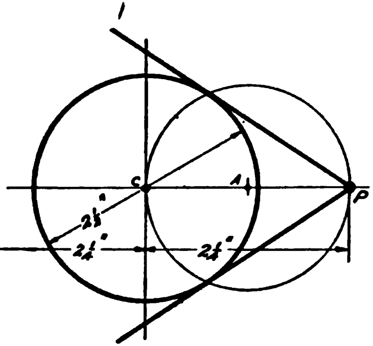
To inscribe four circles within a square tangent to two sides



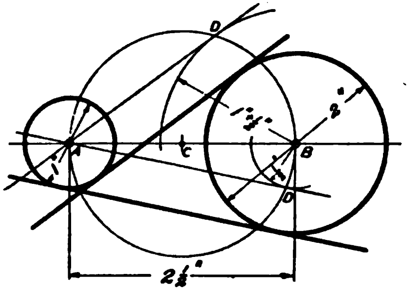
To inscribe four circles within a square tangent to one side.

1¼"

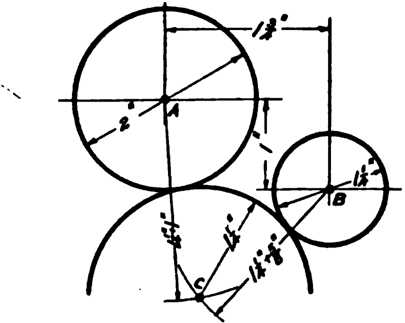
Note: Omit dimensions, but provide construction in fine red lines.



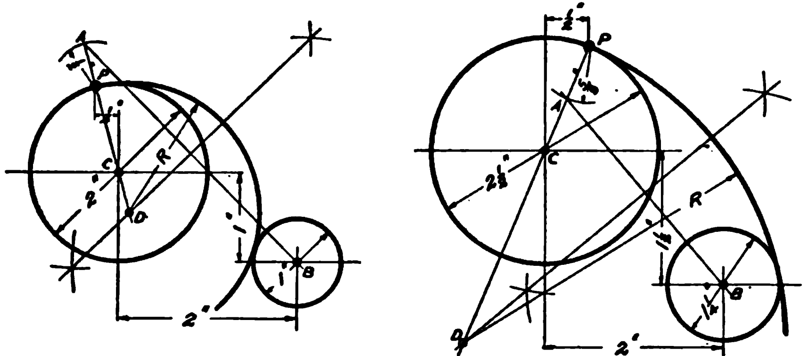
To draw tangents from a given point to a given circle



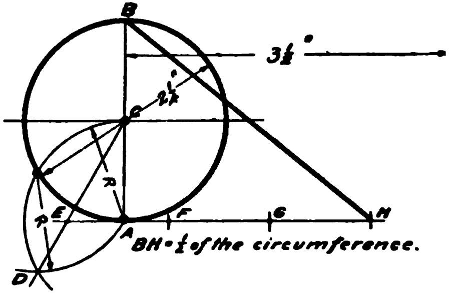
To draw a tangent to two given circles.



To draw a given circle C tangent to two other circles.



To draw a circle tangent to two circles through a point on the circumference of one of the given circles.

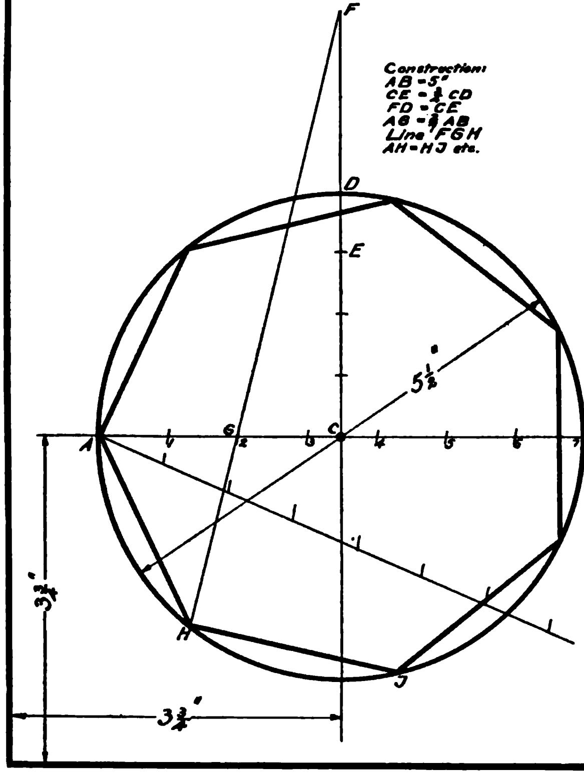


To lay out the circumference of a given circle as a straight line.

Note: Omit dimensions, but provide construction in fine red lines.

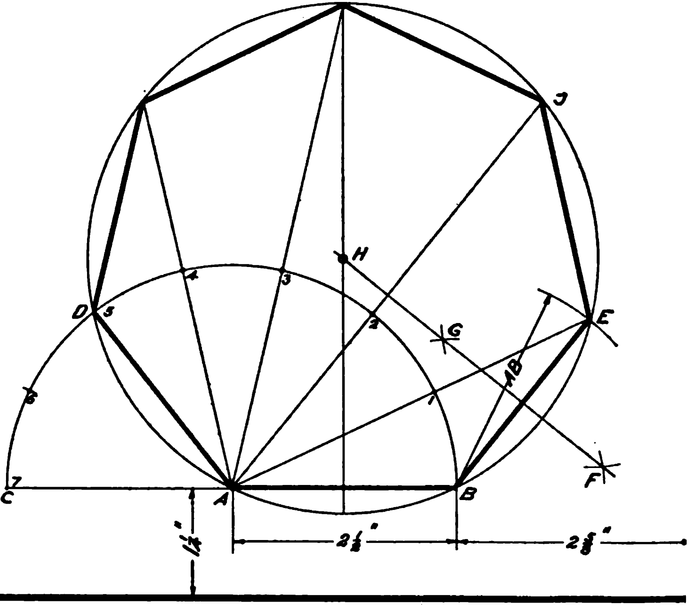
To construct a polygon of any number of sides (in this case 7) within a given circle.

Construction:
AB = 5"
CE = ¾ CD
FD = CE
AG = 2/7 AB
Line FGH
AH = HJ etc.



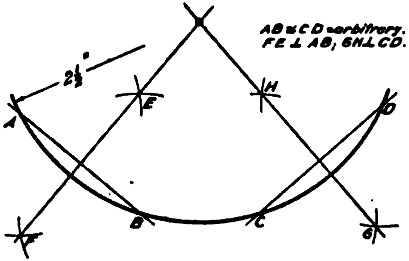
To construct a polygon of any number of sides (in this case 7) upon a given line.

Construction: AB = 2½"
Half circle with R = AB
B-1 = 1-2 etc. = 1/7 of Arc BC
Arc BE. FG ⊥ BE
Line FGH
Circle with Centre H; R = HB
JE = BE etc.

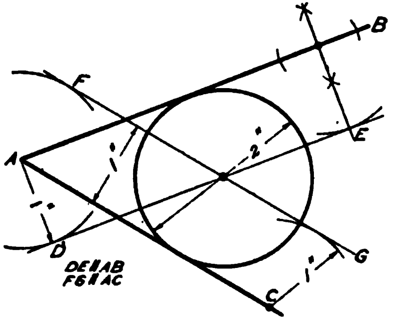


Note: Omit dimensions, but provide construction in fine red lines, printing in black ink.

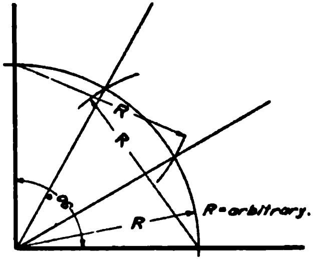
PLATE ☐



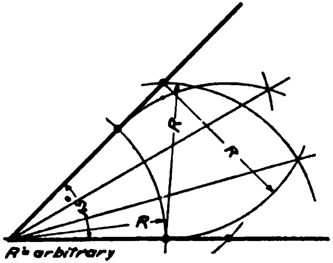
To find the centre of a given arc.



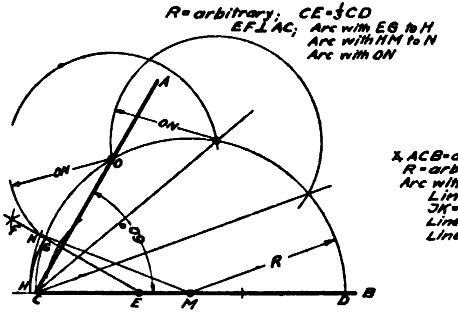
To draw a given circle tangent to two intersecting lines



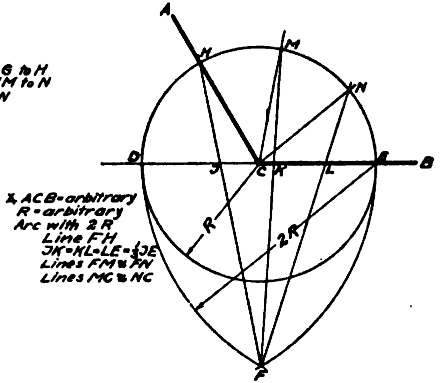
To trisect an angle of 90°



To trisect an angle of 45°

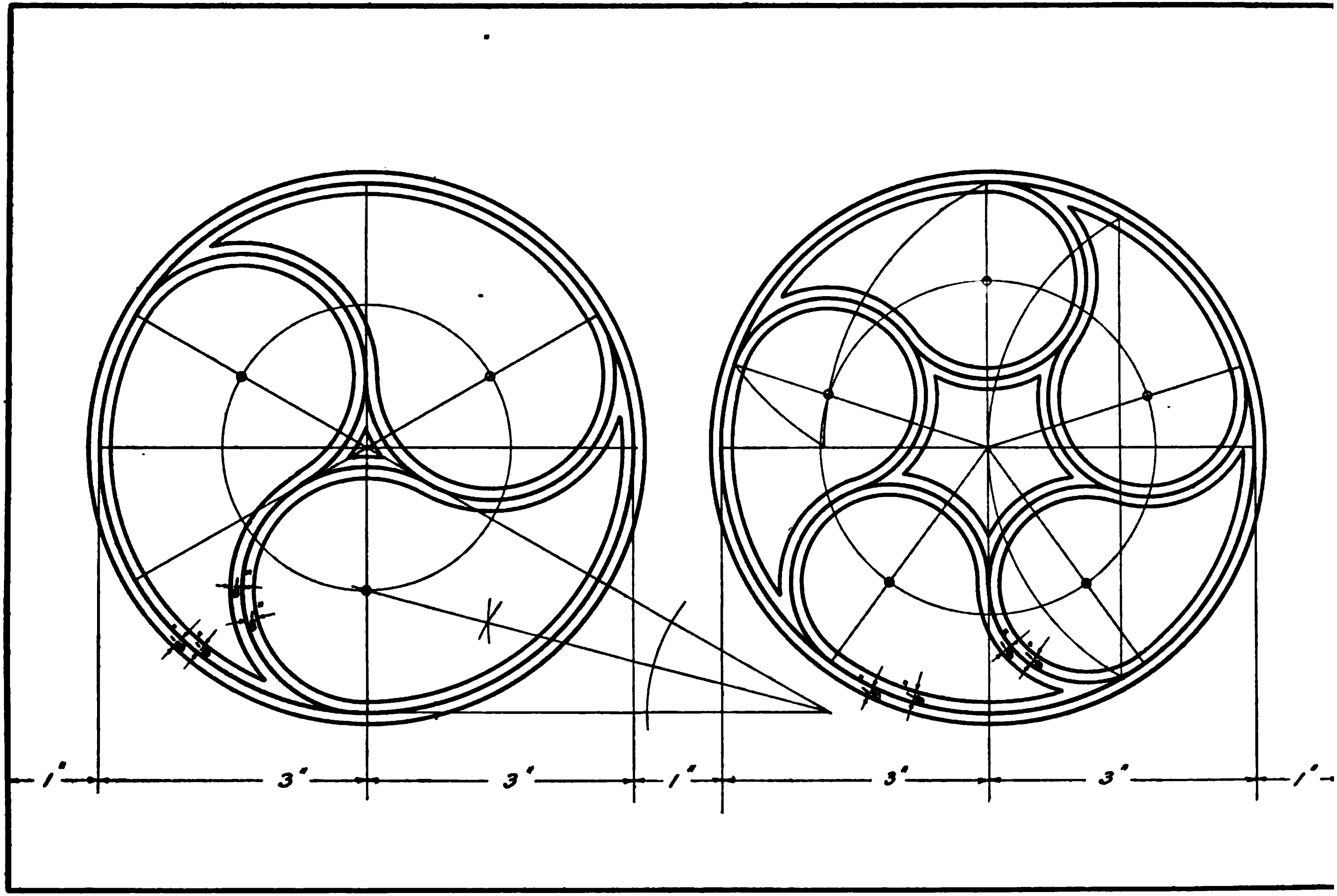


To trisect an angle of 60°



To divide any angle into any number of equal parts, in this case 3.

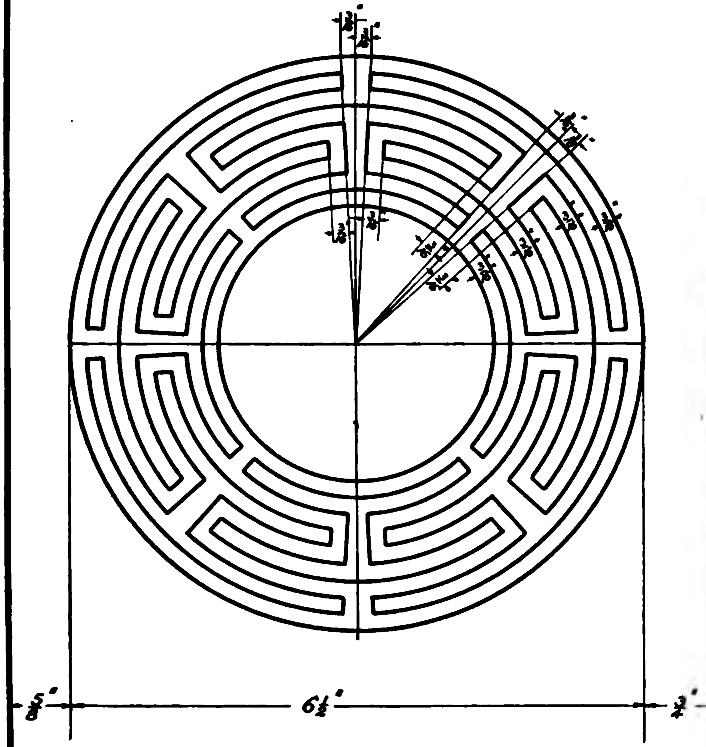
Note: Omit dimensions, but provide construction in fine red lines and printing in black

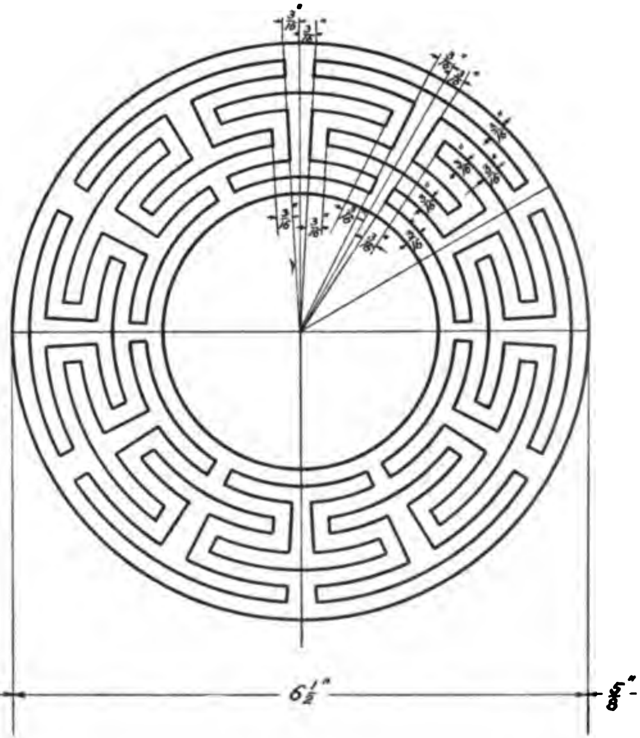


Note: Omit dimensions and construction lines.

PLATE ☐

## Design for flat Tinting

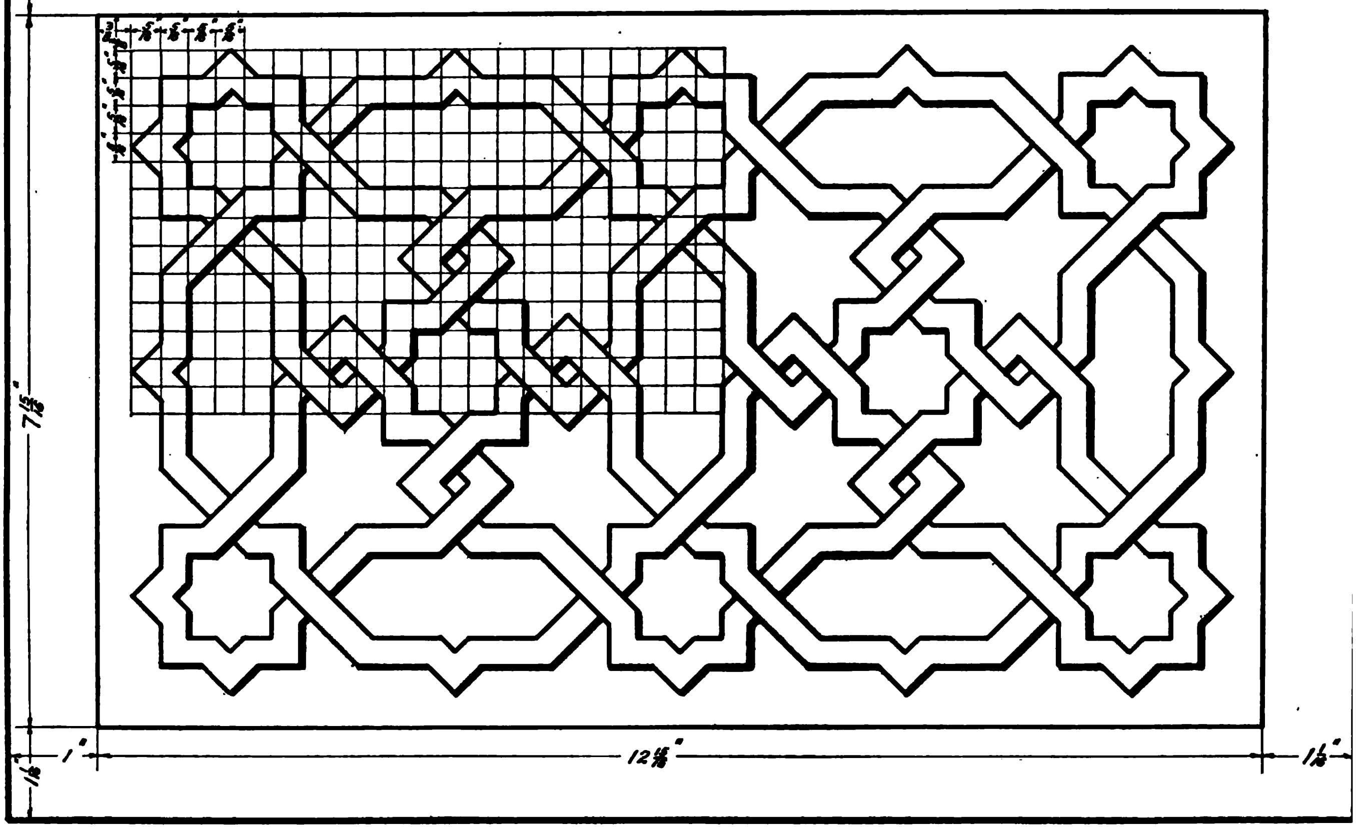




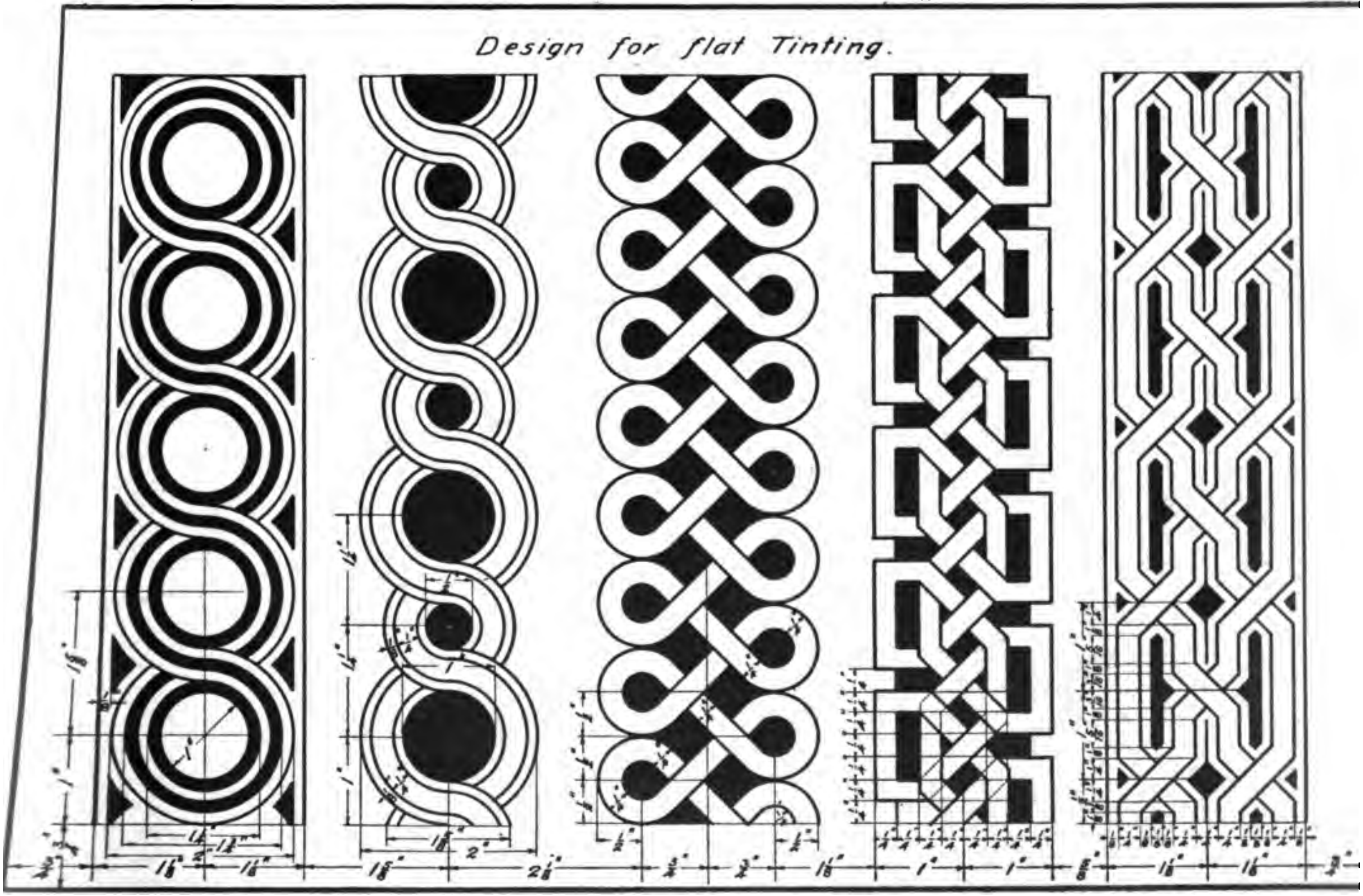
Note Omit dimensions Use 2 or more different colors

PLATE ☐

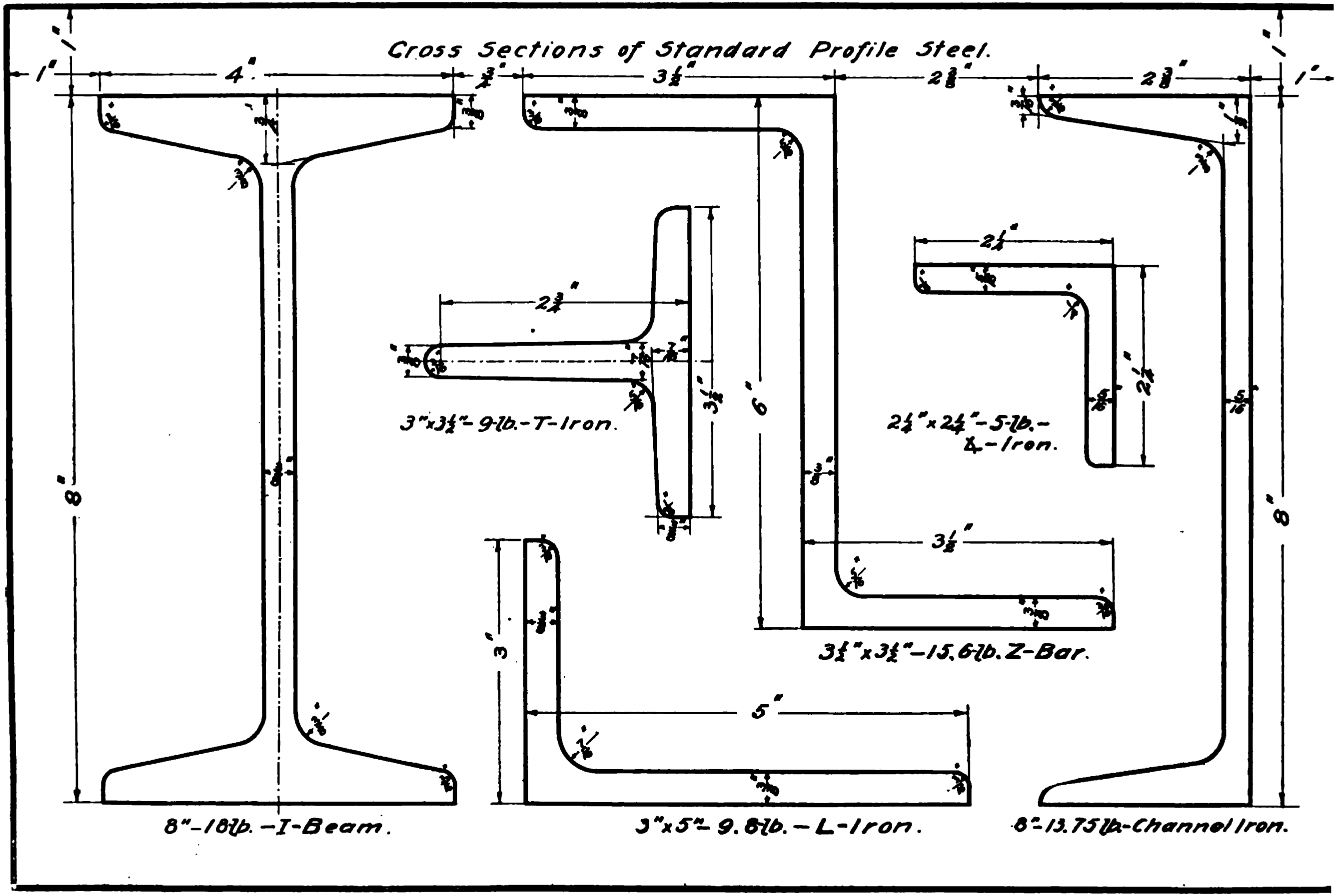
## Design for flat Tinting.



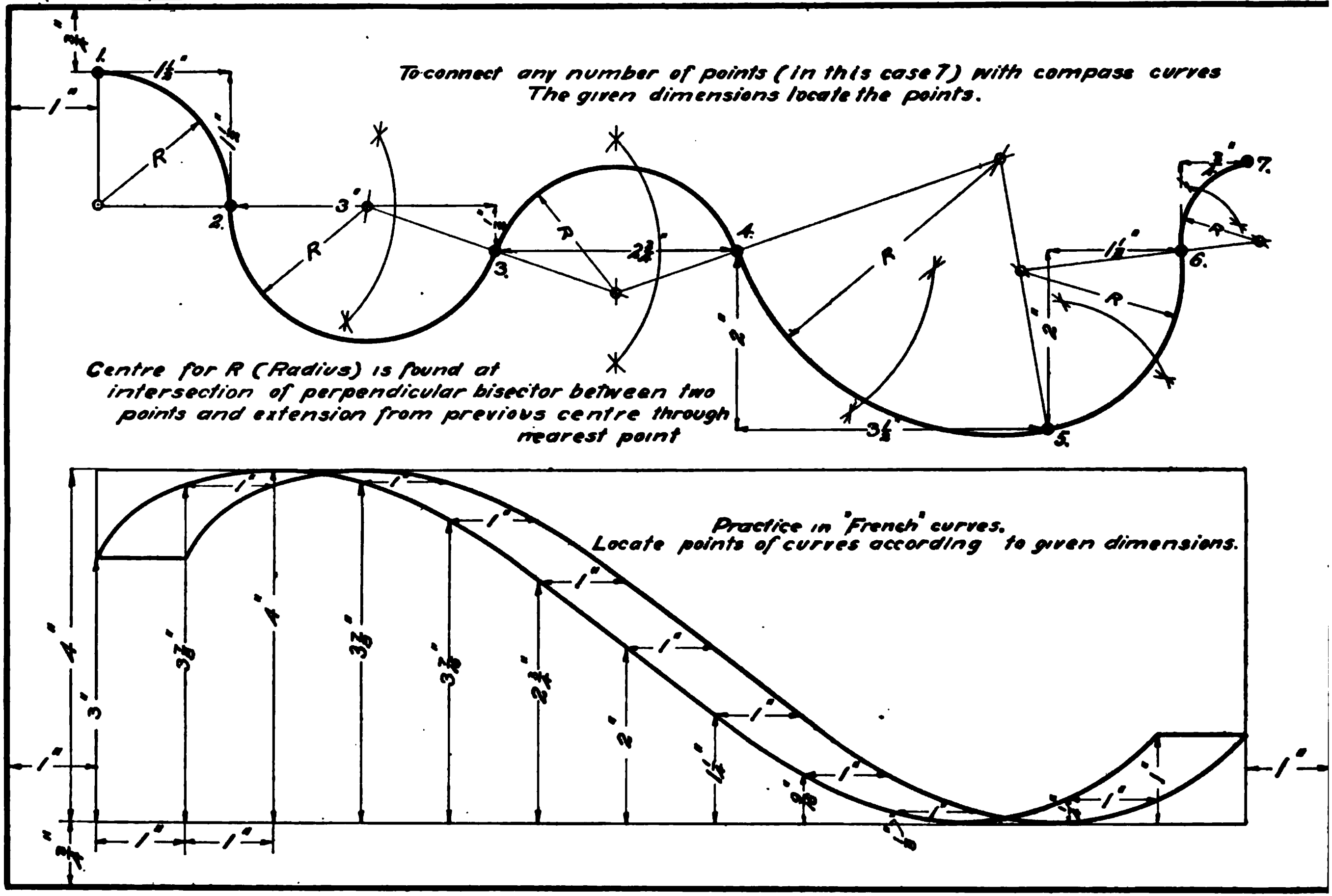
Note: Omit dimensions. Use 2 or more different colors.



ote: Omit dimensions



Note: Omit dimensions, but provide printing. Give cross sections a flat tint of light blue.



To connect any number of points (in this case 7) with compass curves
The given dimensions locate the points.

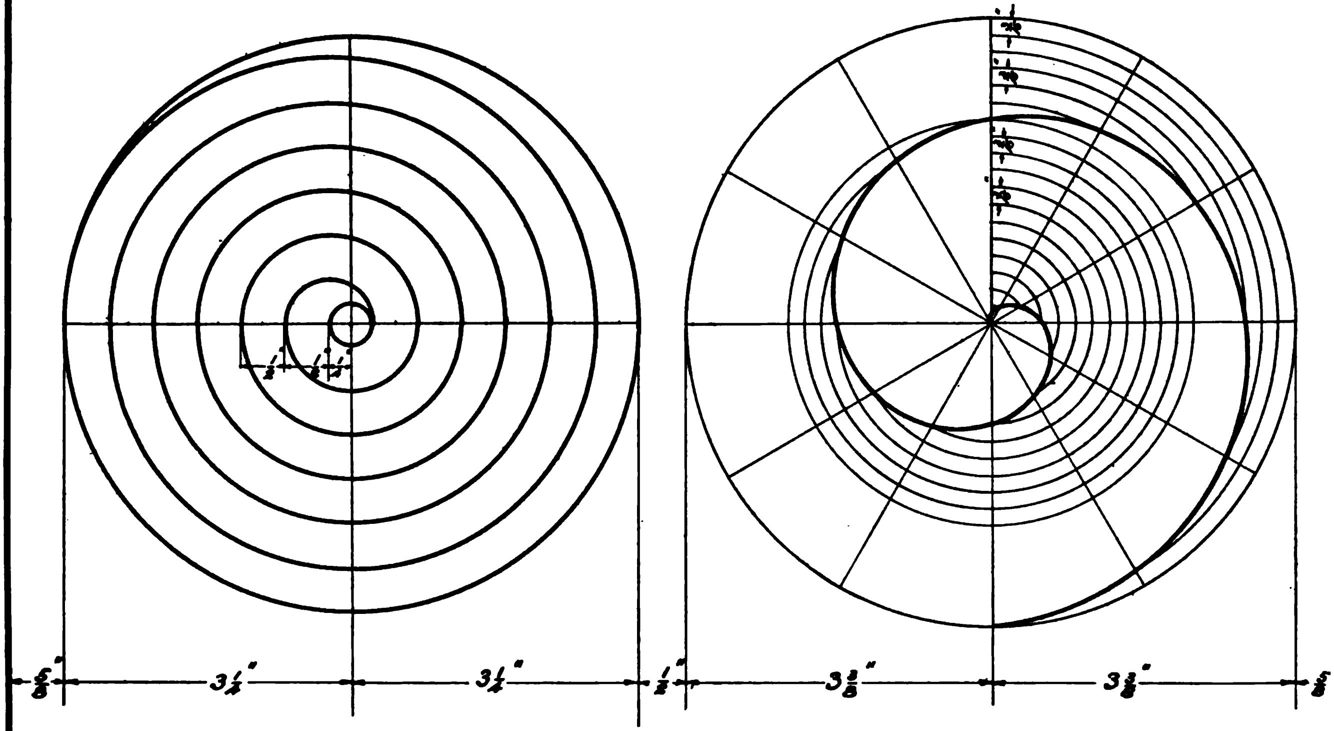
Centre for R (Radius) is found at
intersection of perpendicular bisector between two
points and extension from previous centre through
nearest point

Practice in "French" curves.
Locate points of curves according to given dimensions.

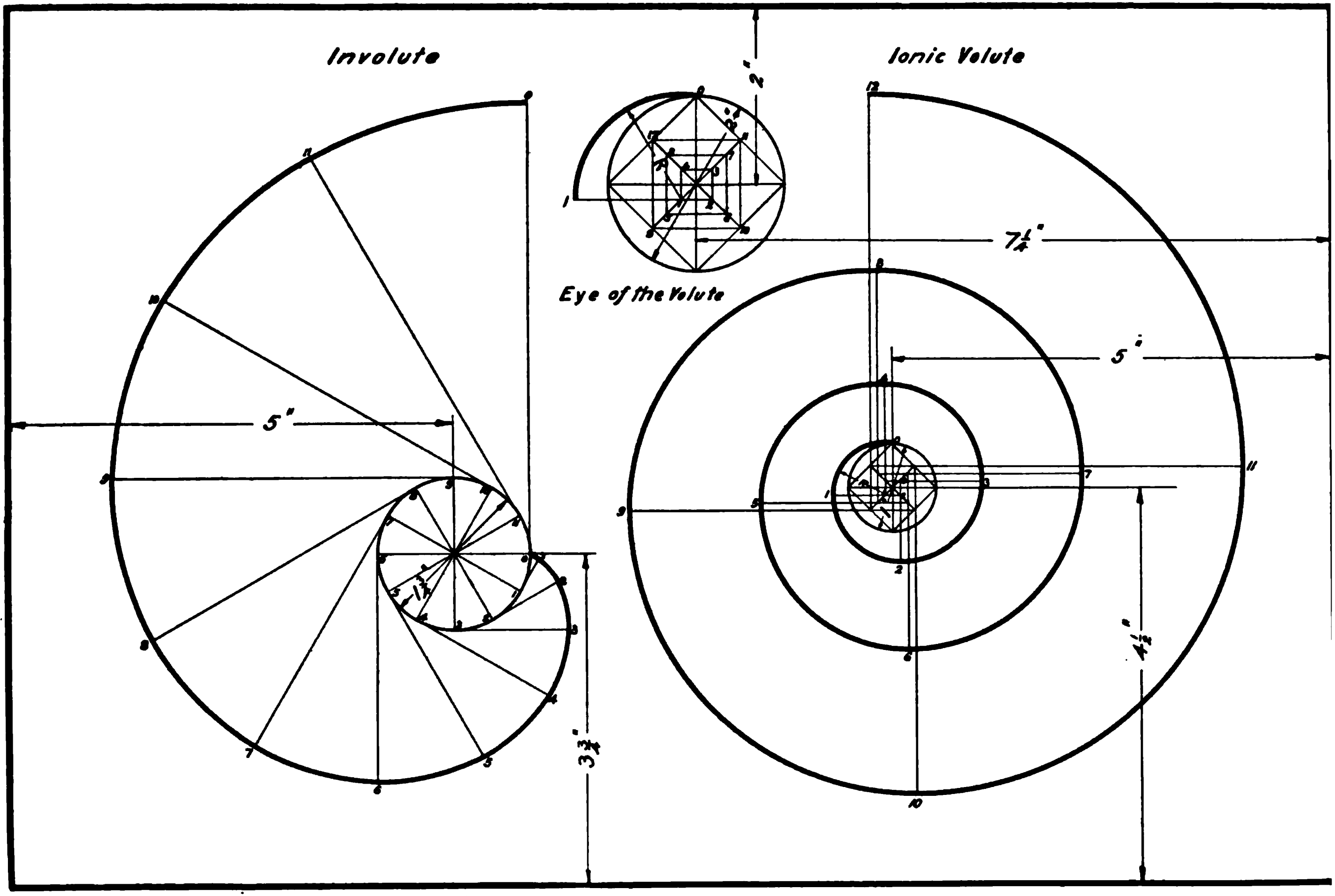
Note: Provide construction lines in upper drawing; omit all dimensions.

PLATE

## Spiral



Note: Omit dimensions



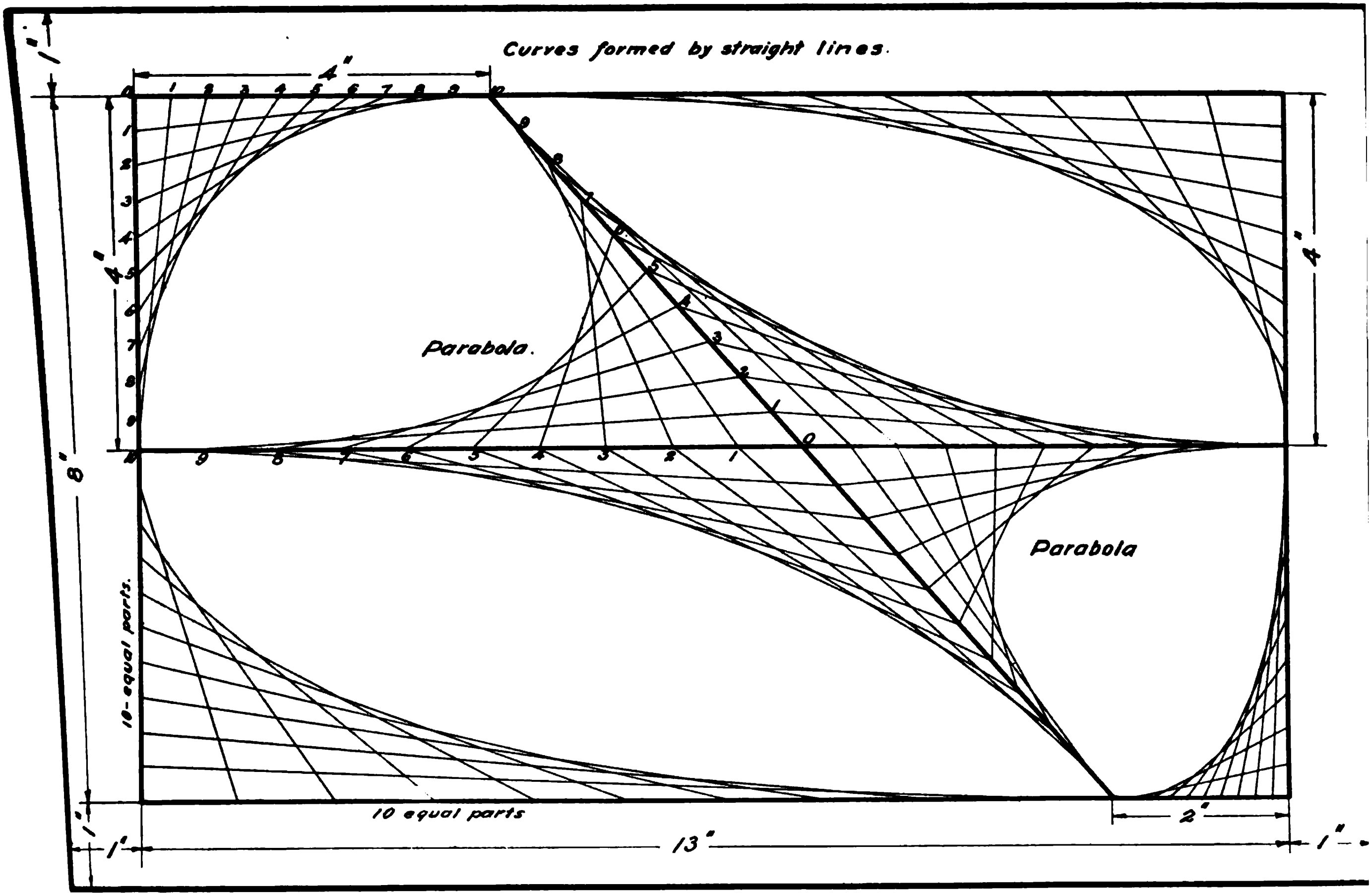
Involute

Eye of the Volute

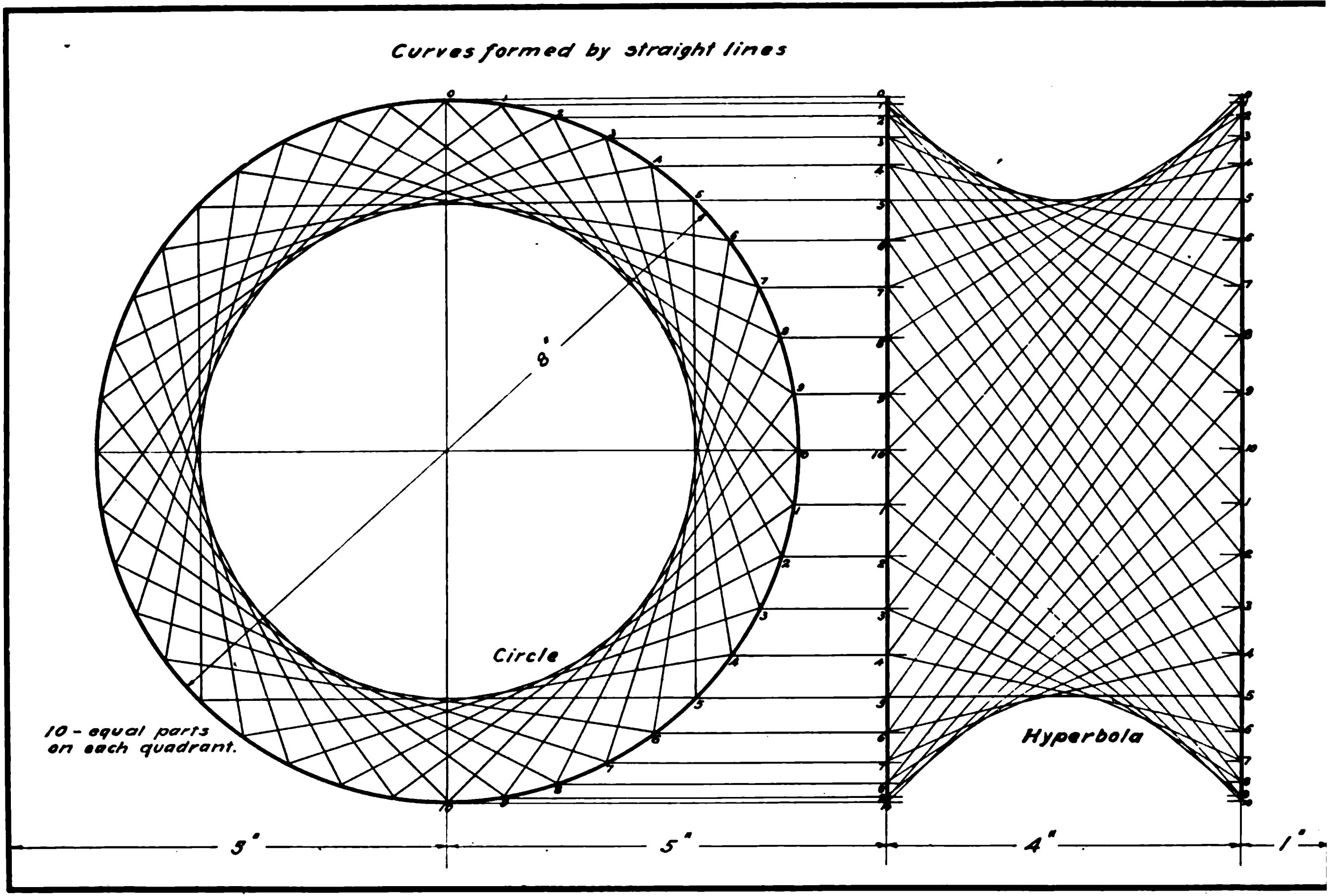
Ionic Volute

Note: Omit dimensions, but provide construction in fine red lines, printing and numerals in black

PLATE ☐



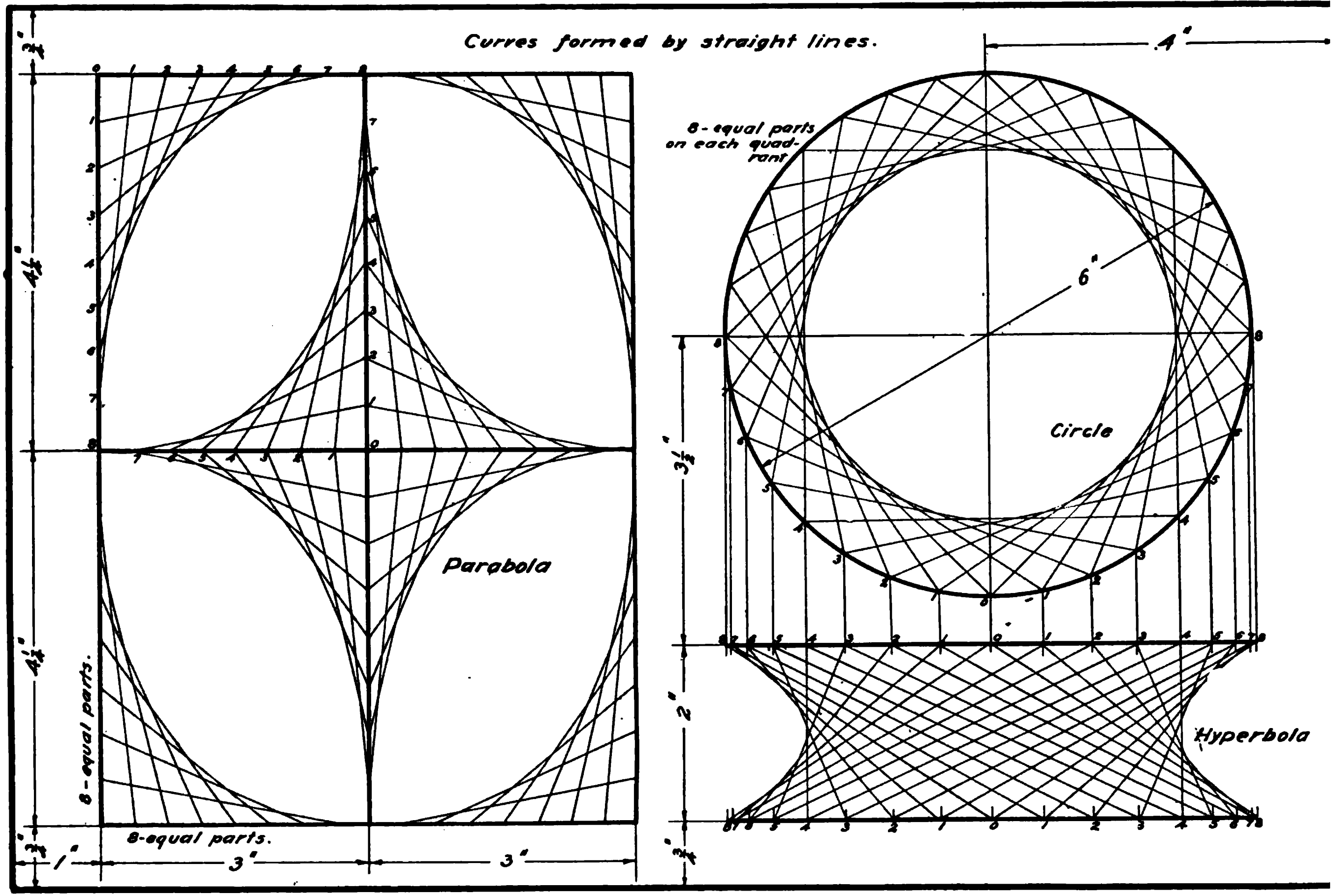
*Note: Omit dimensions, but provide construction in fine red lines; numerals and printing*



Curves formed by straight lines

*Note: Omit dimensions, but provide construction in fine red lines; numerals and printing in black*

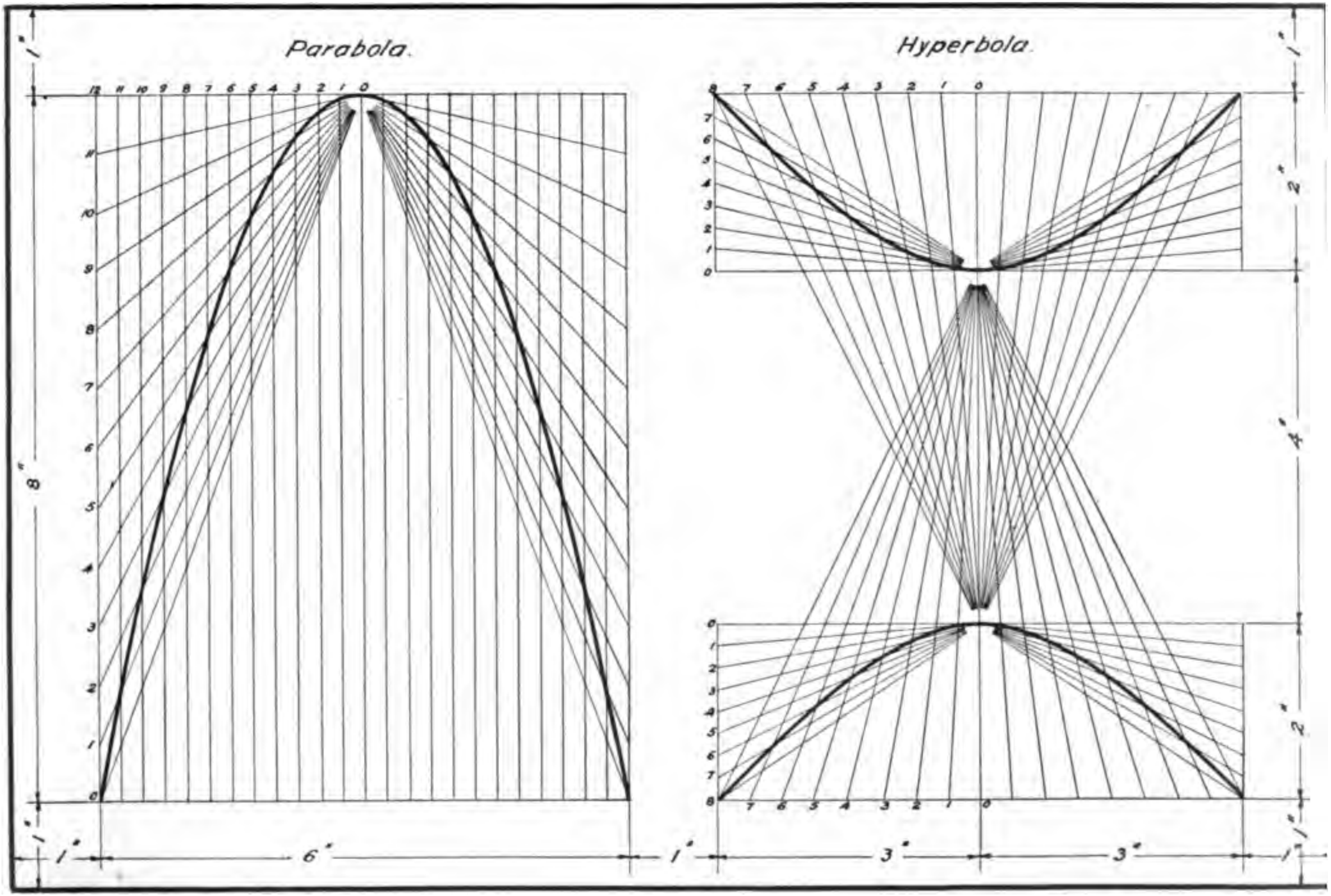
PLATE



Curves formed by straight lines.

*Note: Omit dimensions, but provide construction in fine red lines, numerals and printing in black.*

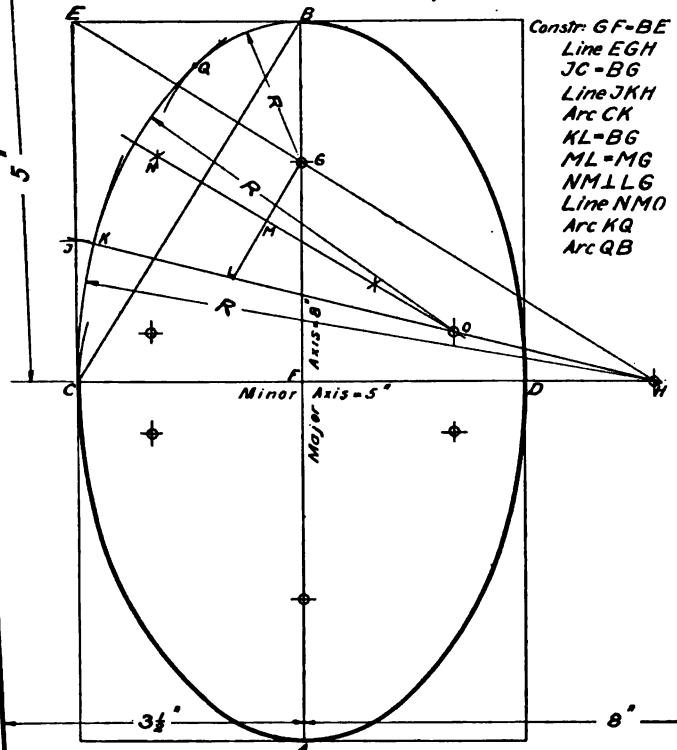
PLATE



*Note: Omit dimensions, but provide construction in fine red lines.*

PLATE ☐

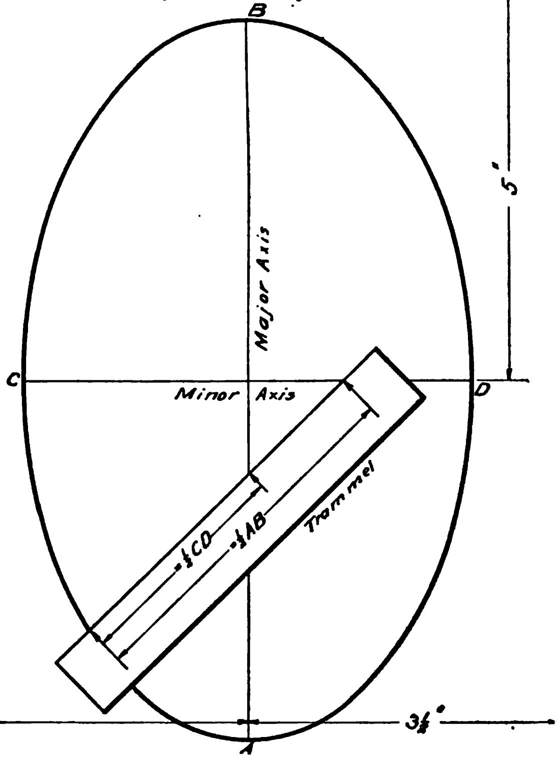
Ellipse
Drawn with the compass.



Constr: GF=BE
Line EGH
JC=BG
Line JKH
Arc CK
KL=BG
ML=MG
NM⊥LG
Line NMO
Arc KQ
Arc QB

AB=8"; CD=5"

Ellipse
Drawn by means of a trammel.

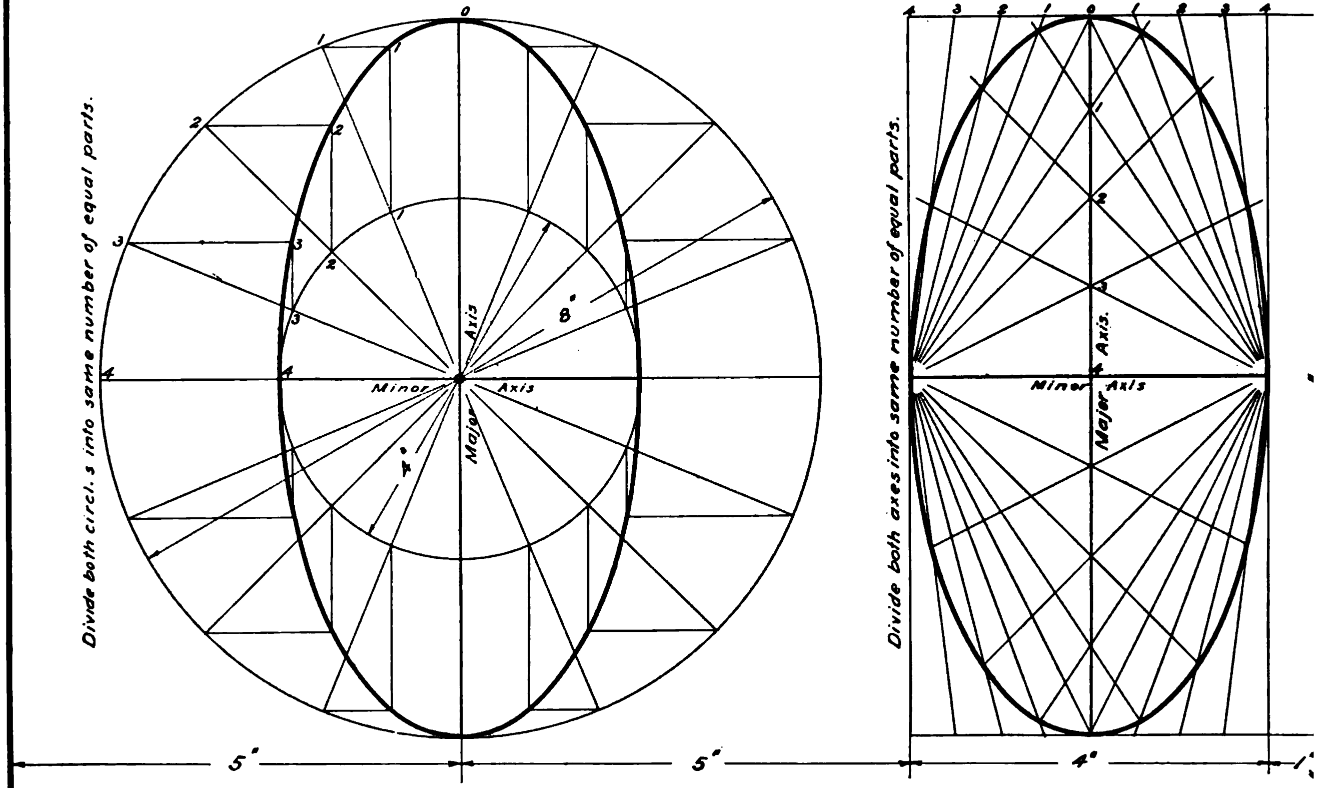


AB=8"; CD=5".

Note: Omit dimensions, but provide construction in fine red lines and printing in black ink.

PLATE ☐

# Ellipse



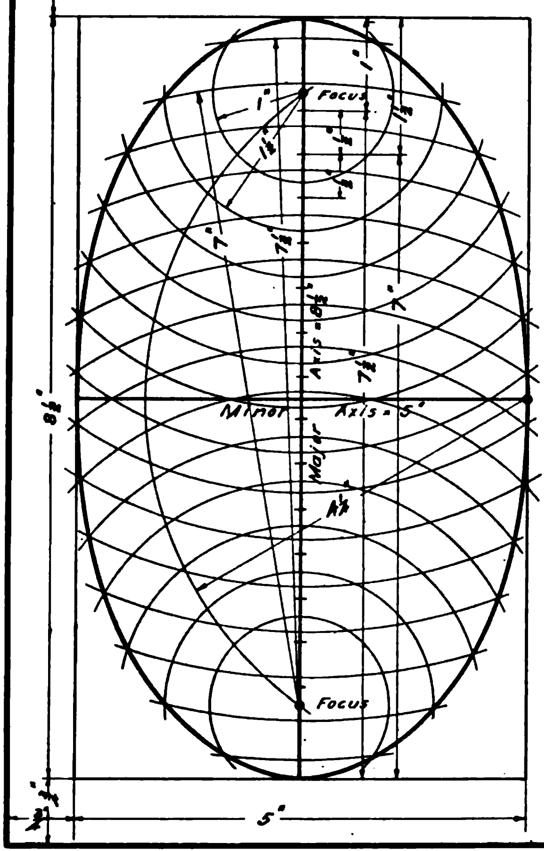
Divide both circles into same number of equal parts.

Divide both axes into same number of equal parts.

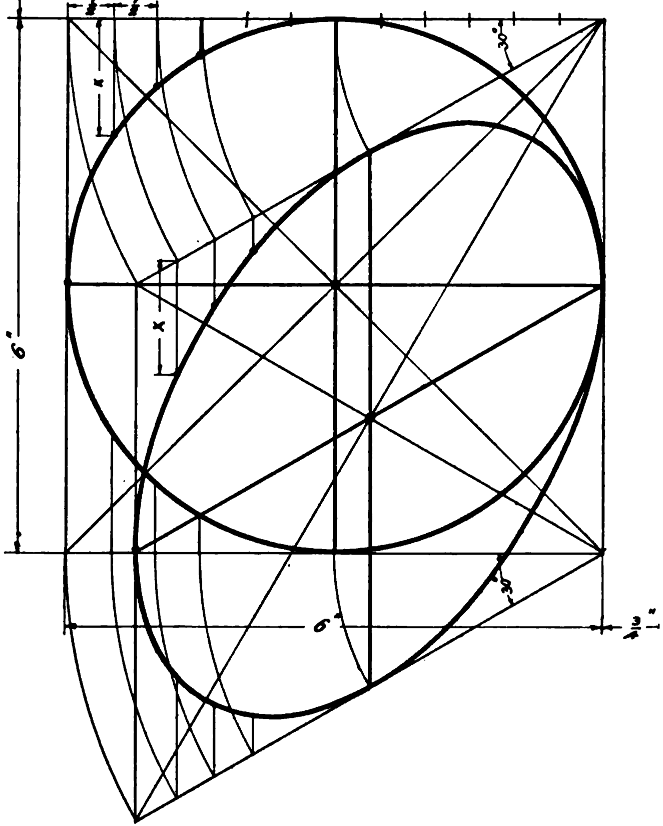
Note: Omit dimensions, but provide construction in fine red lines, numerals in black ink.

PLATE ☐

Ellipse.

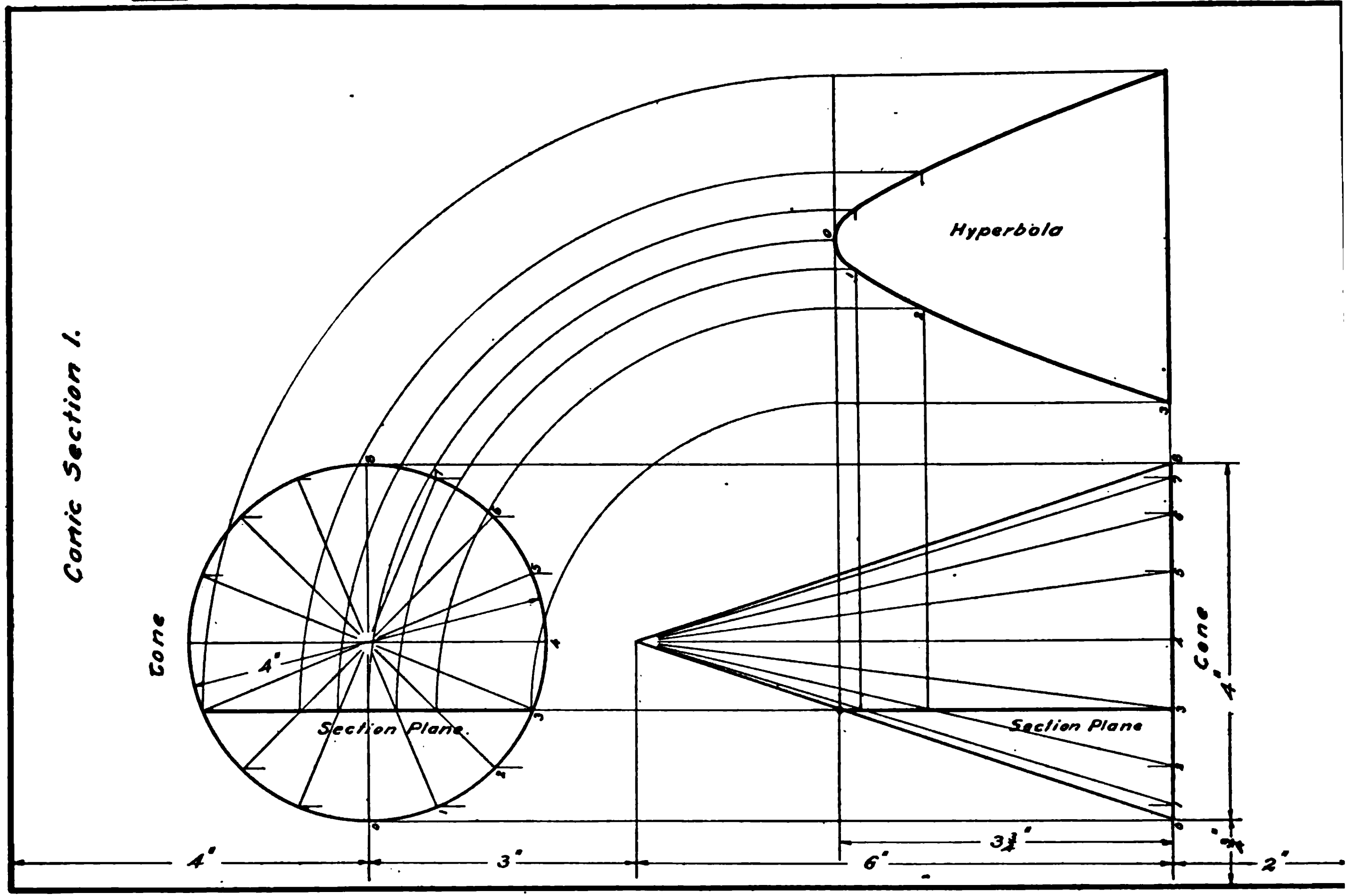


Circle and Ellipse.

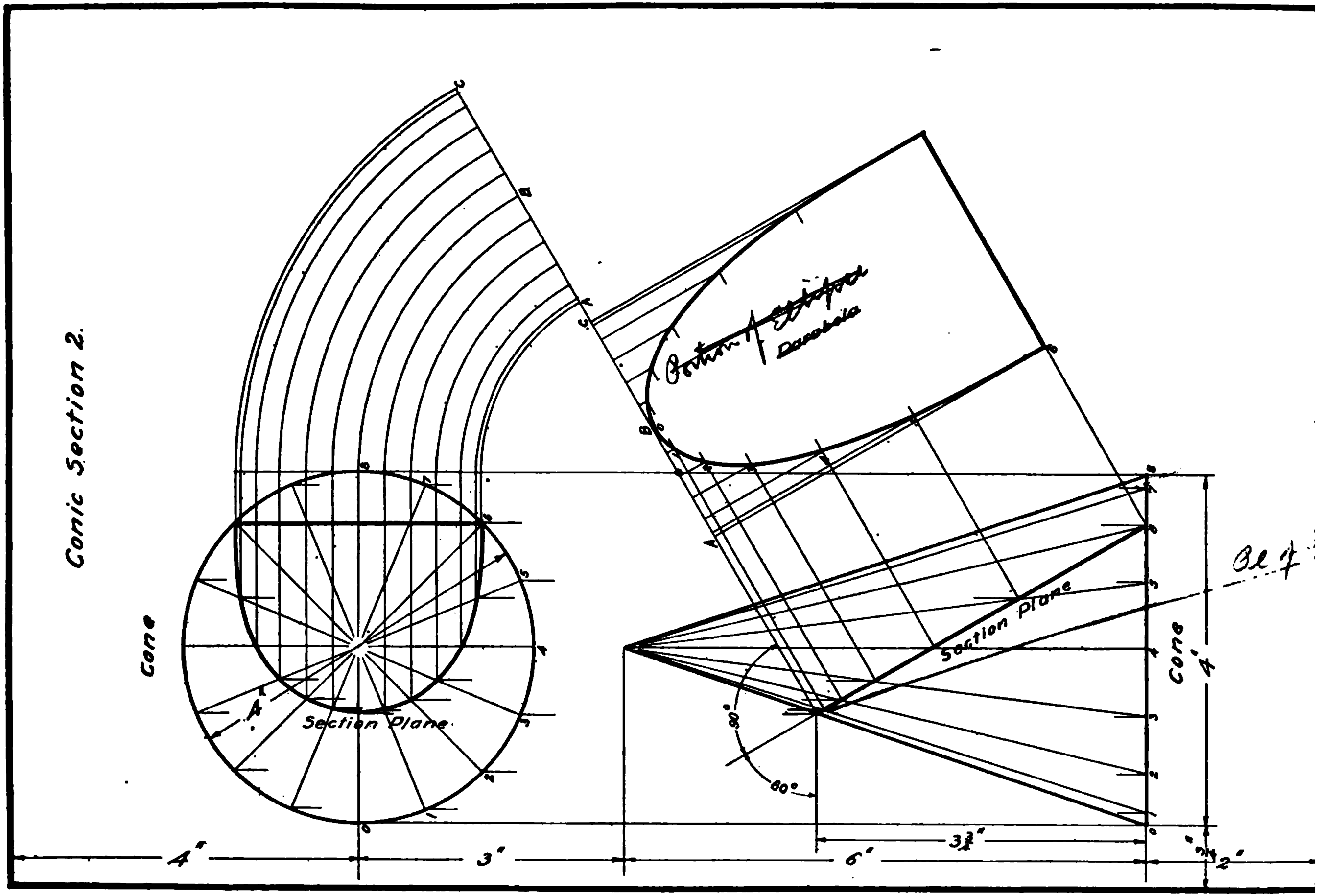


Note: Omit dimensions, but provide construction in fine red lines; numerals in black ink.

PLATE ☐

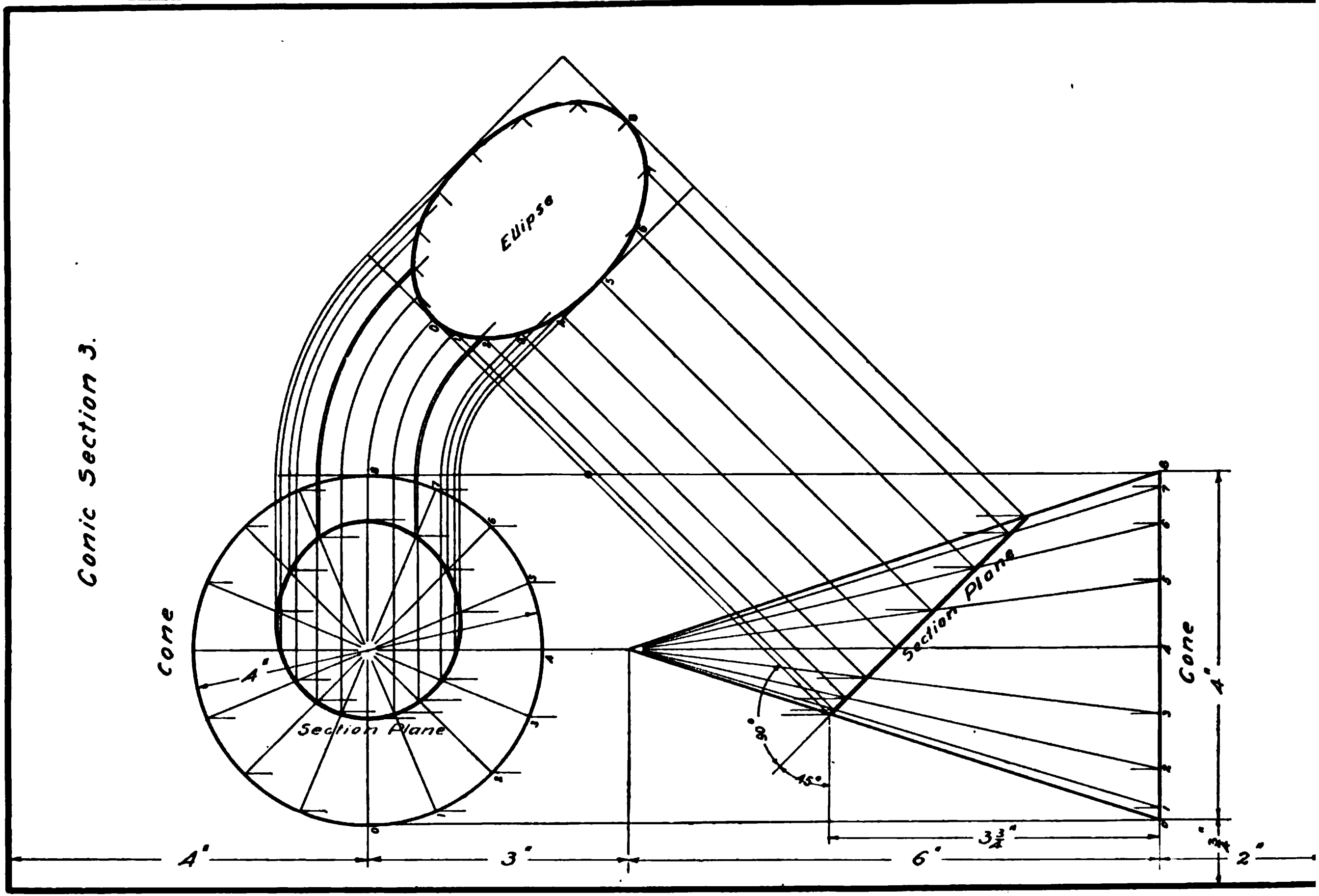


*Note: Omit dimensions, but provide construction in fine red lines.*



*Note: Omit dimensions, but provide construction in fine red lines.*

PLATE ☐



*Note: Omit. dimensions, but provide construction in fine red lines.*

Cycloid.

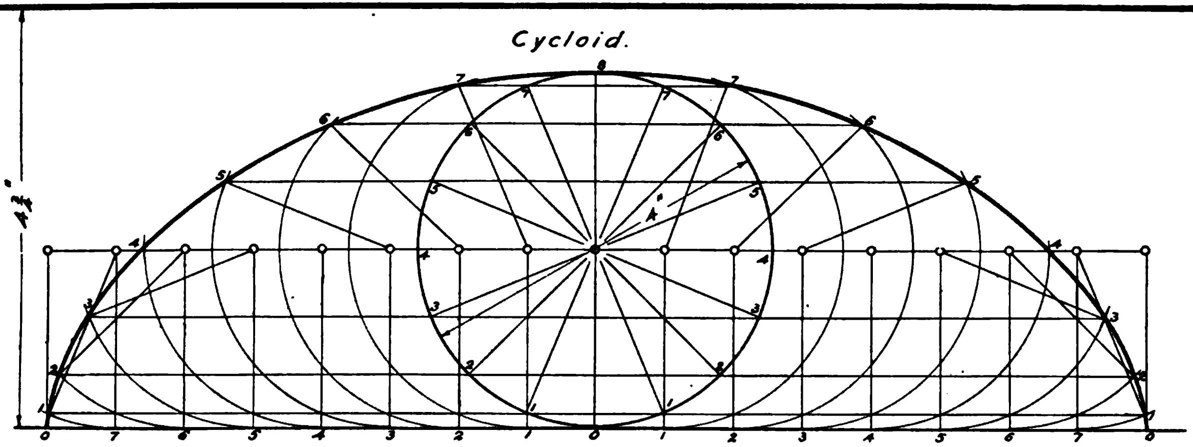
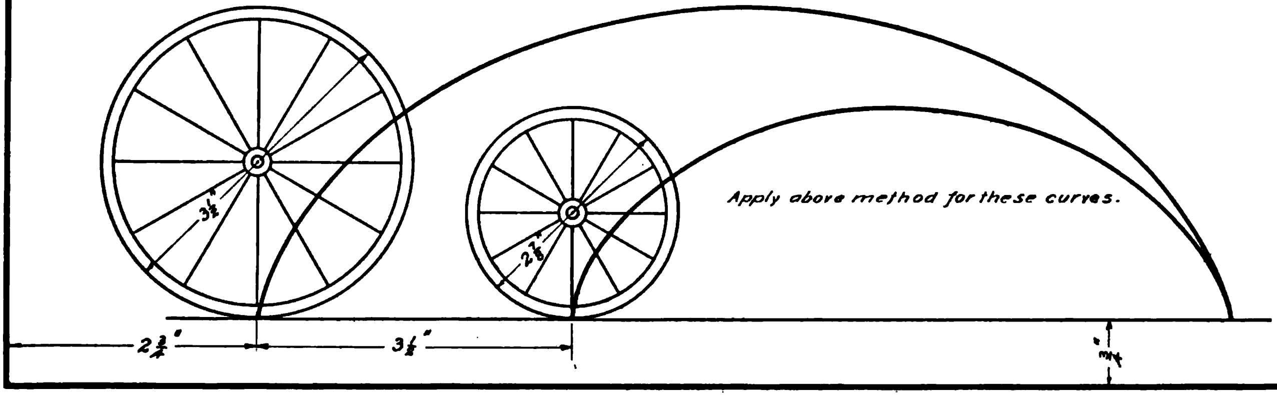


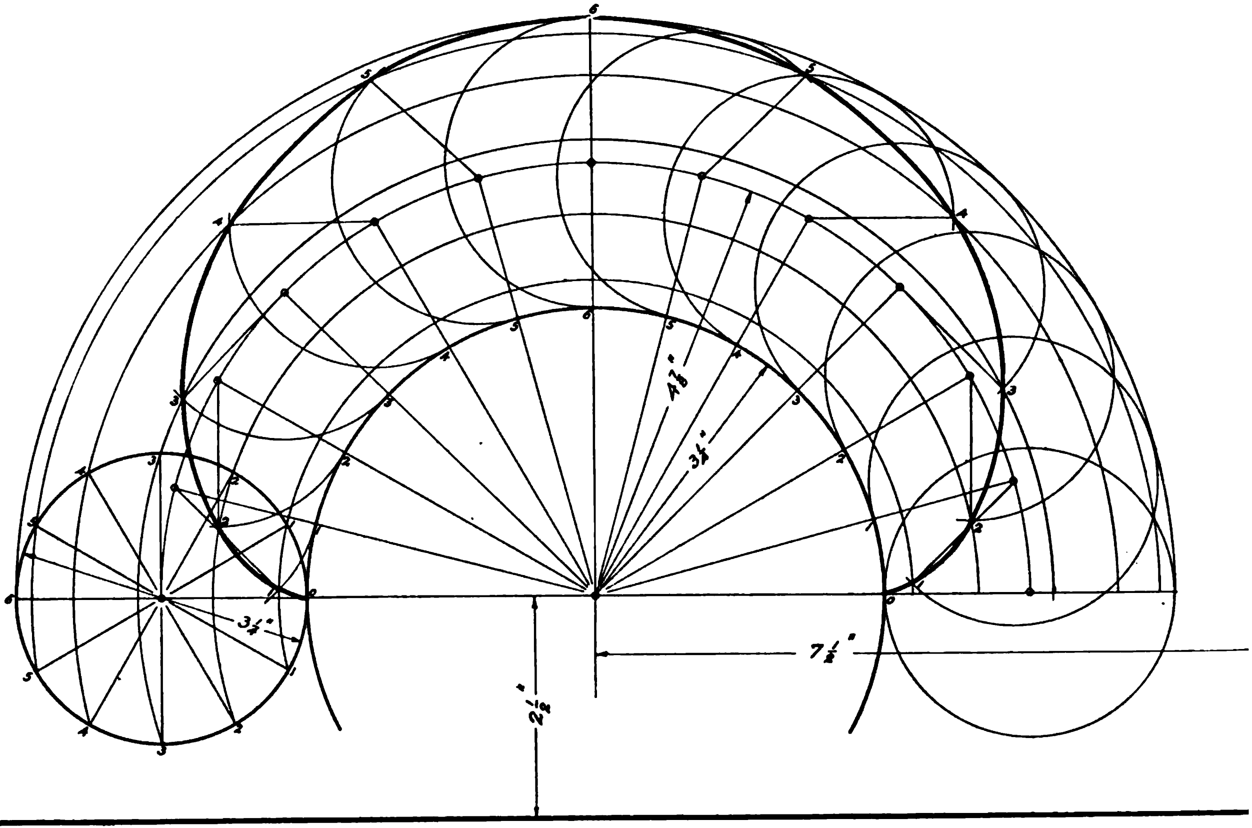
Illustration of a Cycloid.



Apply above method for these curves.

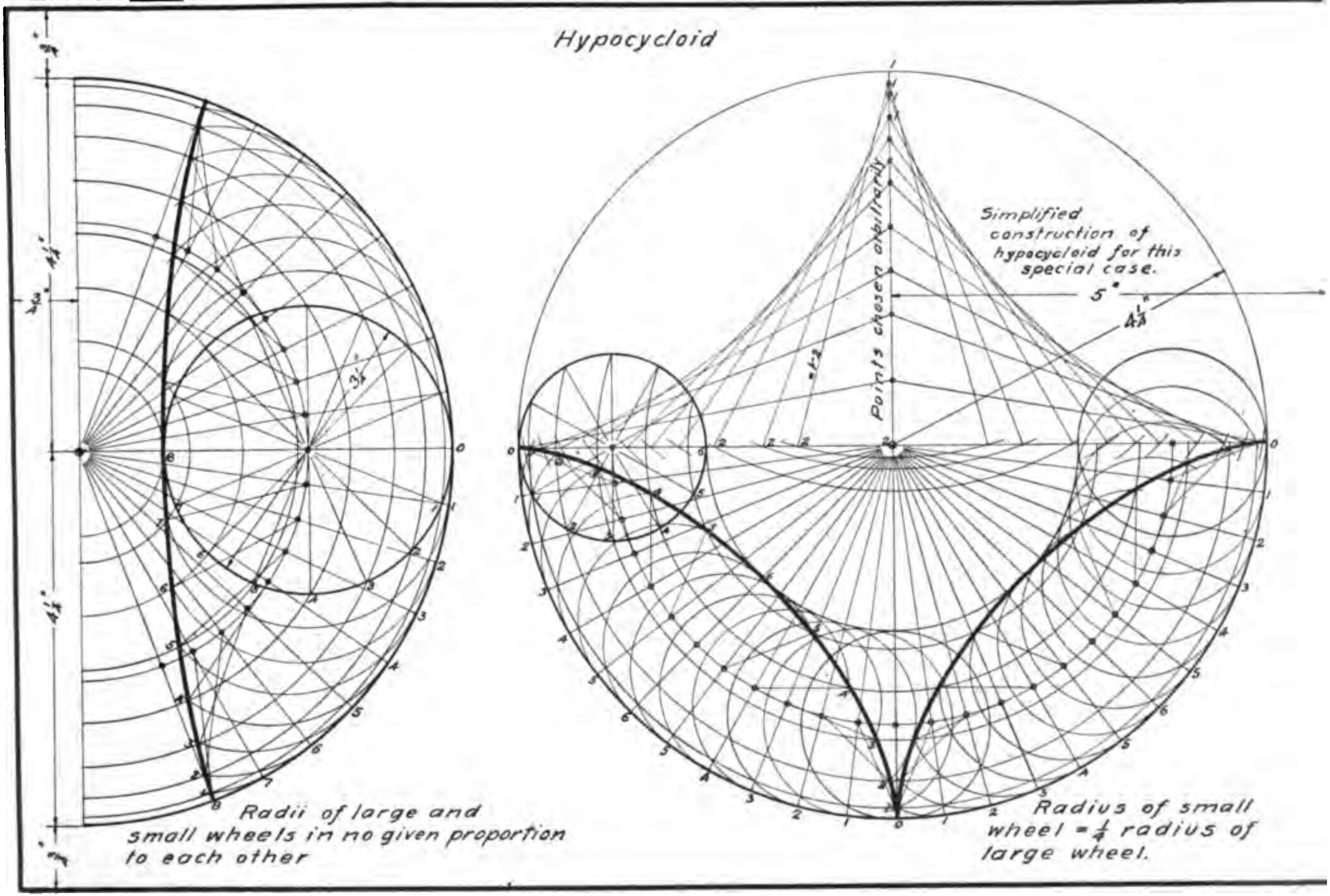
Note: Omit dimensions, but provide construction of cycloid in fine red lines and numer

Epicycloid.



*Note: Omit dimensions, but provide construction in fine red lines and numerals in black ink.*

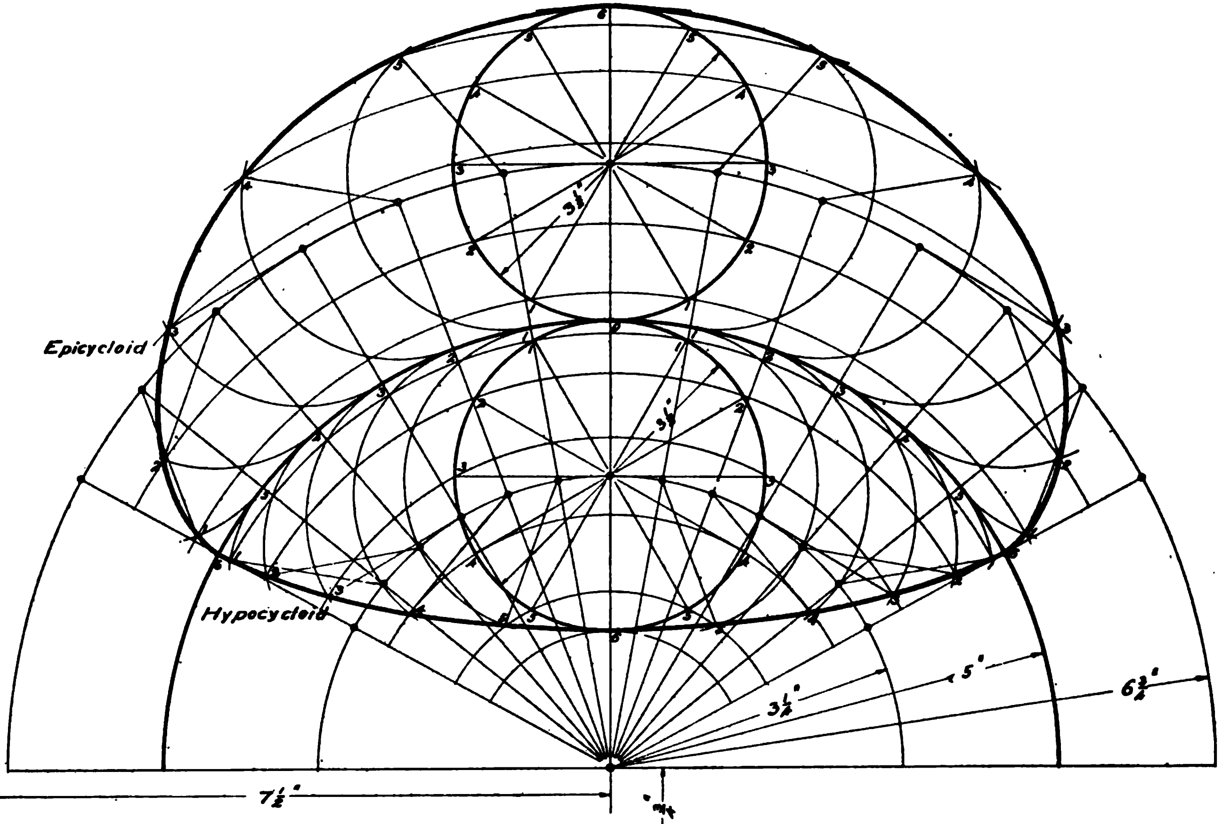
PLATE ☐


Hypocycloid
Simplified construction of hypocycloid for this special case.
5"
4 1/4"
3 1/4"
Points chosen arbitrarily
3/4"
4 1/4"
3/4"
4 1/4"
3/4"
Radii of large and small wheels in no given proportion to each other
Radius of small wheel = 1/4 radius of large wheel.
0
1
2
3
4
5
6
7
8

*Note: Omit dimensions, but provide construction in fine red lines.*

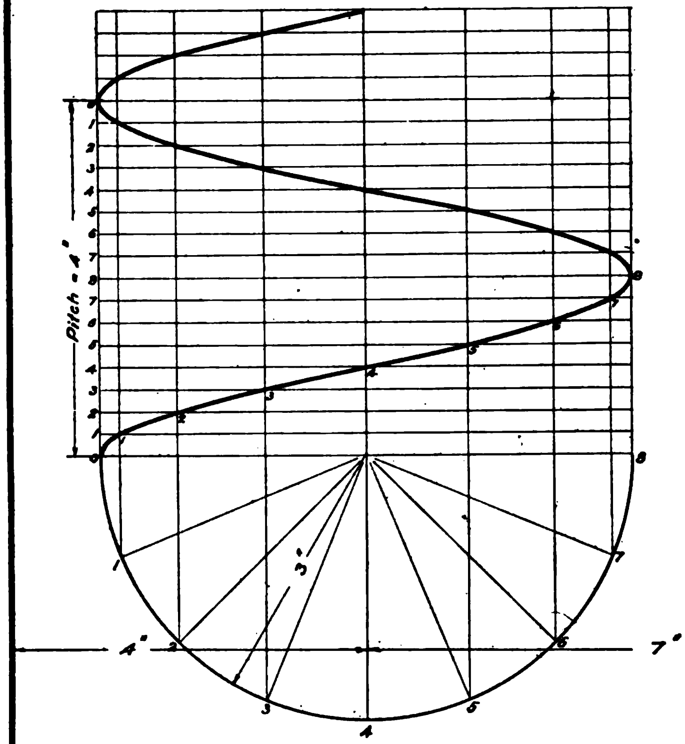
PLATE ☐

## Epi- and Hypo- Cycloid.

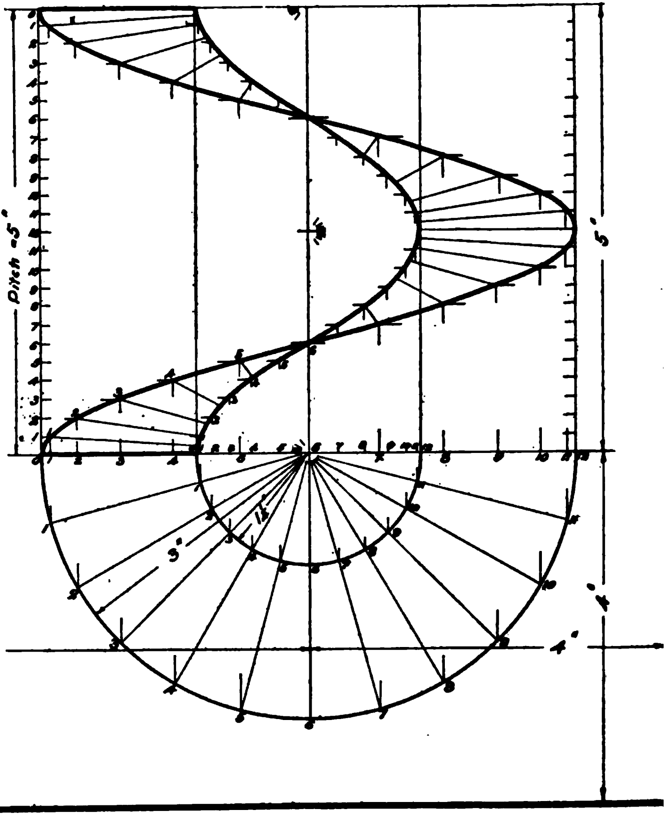


Note: Omit dimensions, but provide construction in fine red lines

Helix

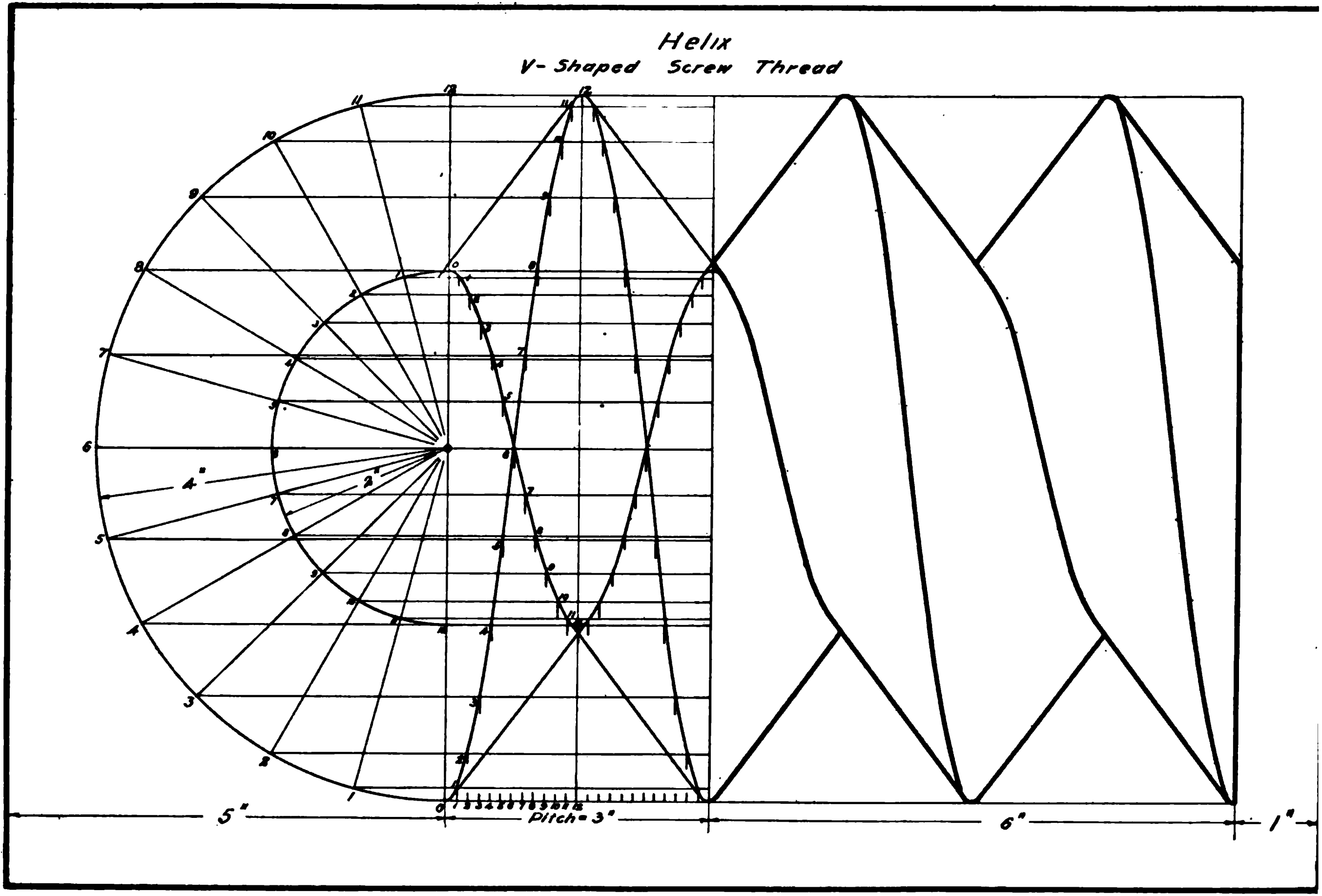


Helical Blade



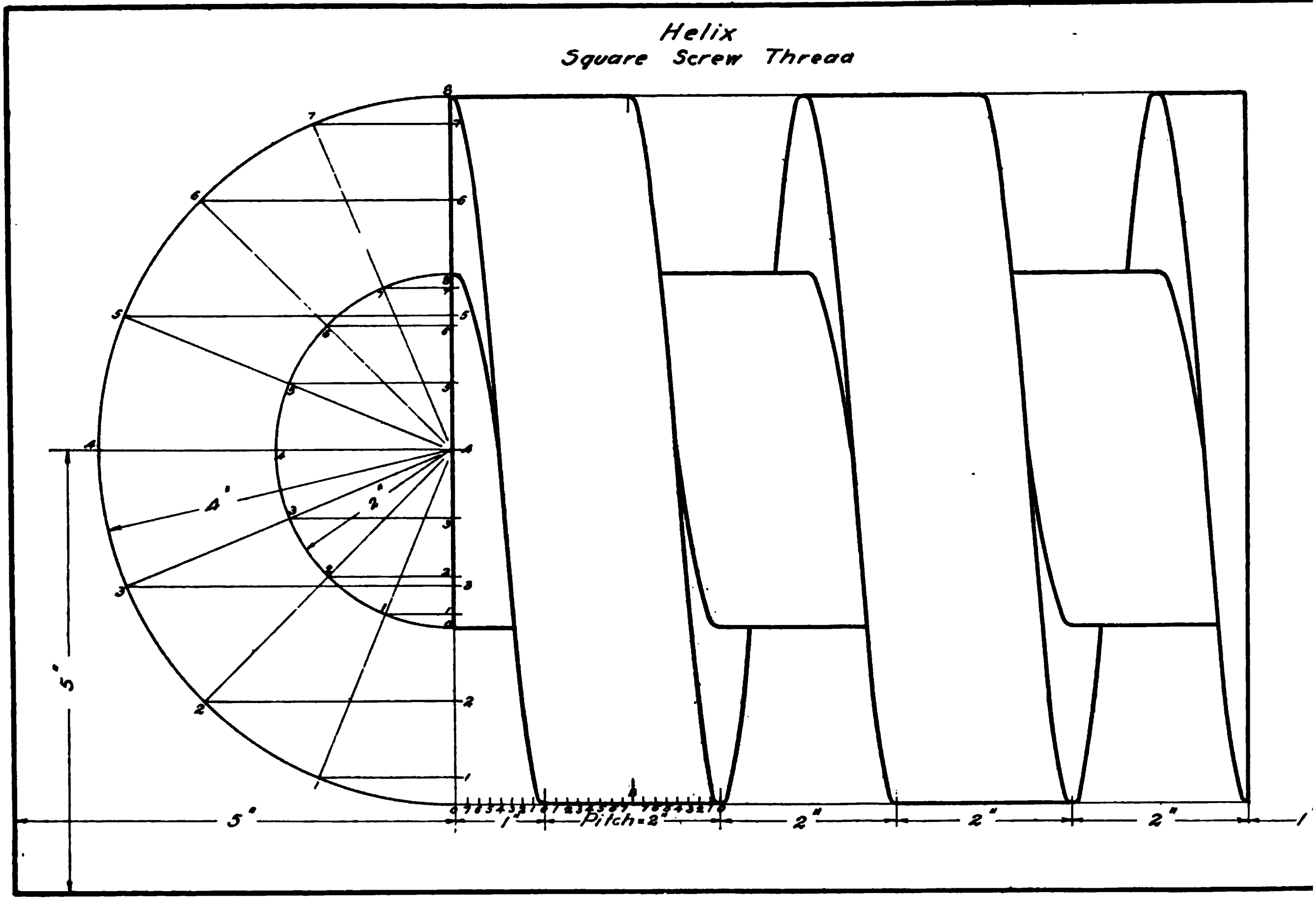
Note: Omit dimensions, but provide construction in fine red lines, numerals in black ink

PLATE ☐



*Note: Omit dimensions, but provide construction in fine red lines and numerals in black ink.*

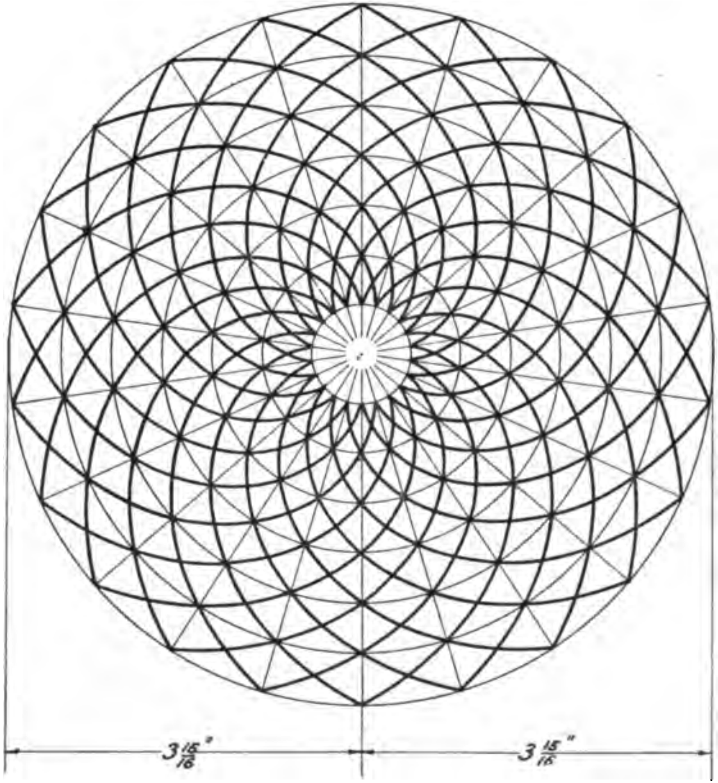
PLATE ☐



*Note. Omit dimensions, but provide construction in fine red lines and numerals in black*

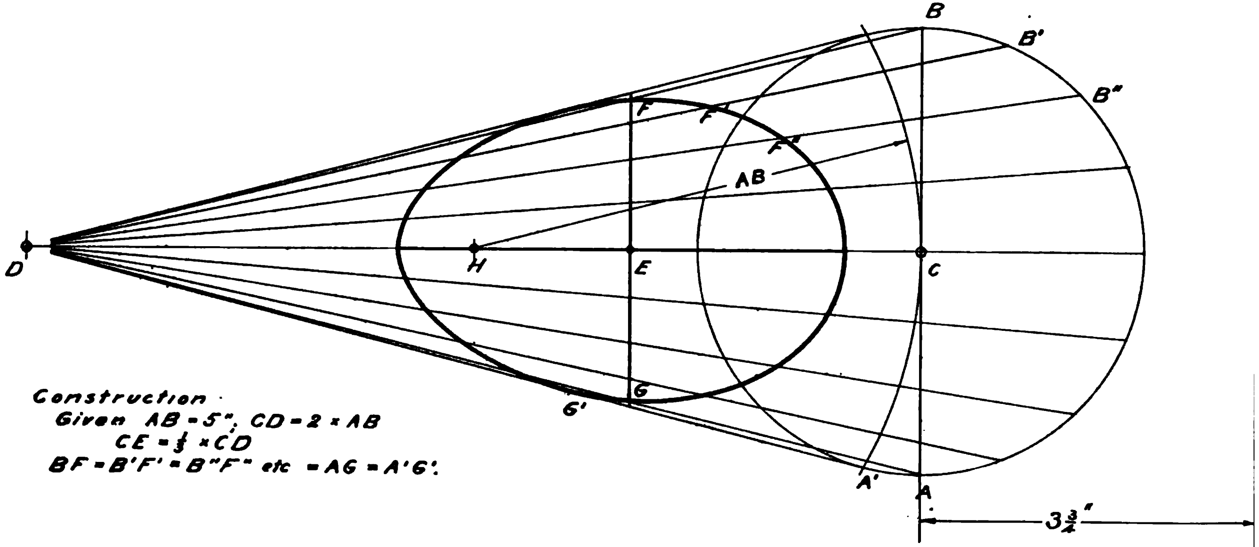
PLATE ☐

# Practice in French Curves.



Note: Omit dimensions, but provide construction in fine red lines. For constructio divide radius into 7 and circumference into 22 equal parts.

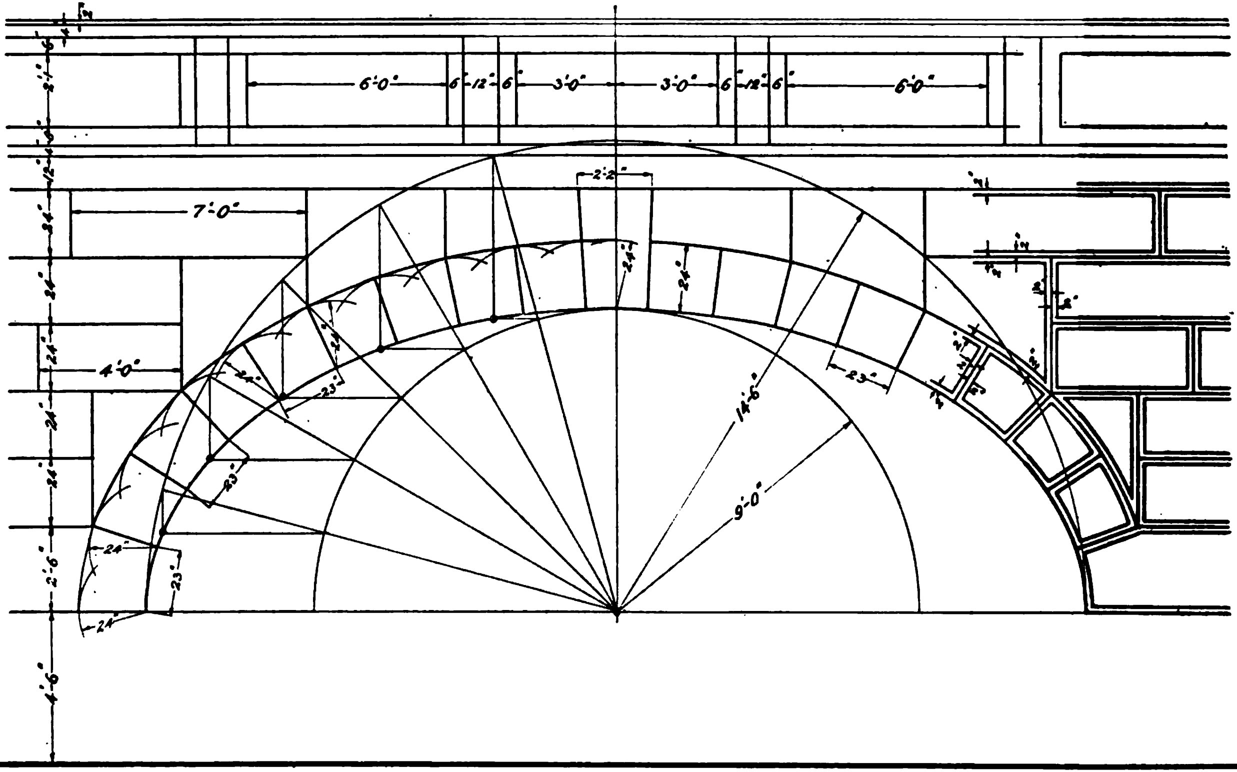
## Egg-Shaped Oval.



Construction.
Given AB = 5". CD = 2 × AB
CE = $\frac{1}{3}$ × CD
BF = B'F' = B"F" etc = AG = A'G'.

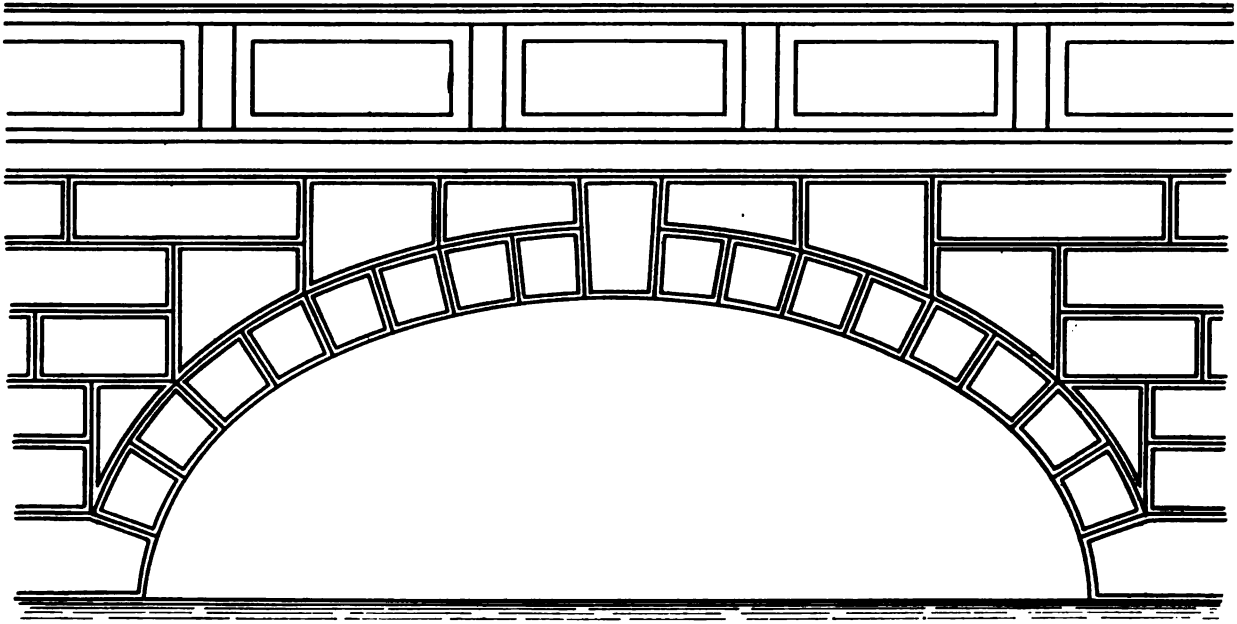
Note: Omit dimension, but provide printing.

## Practical Application of the Ellipse.
## (construction)



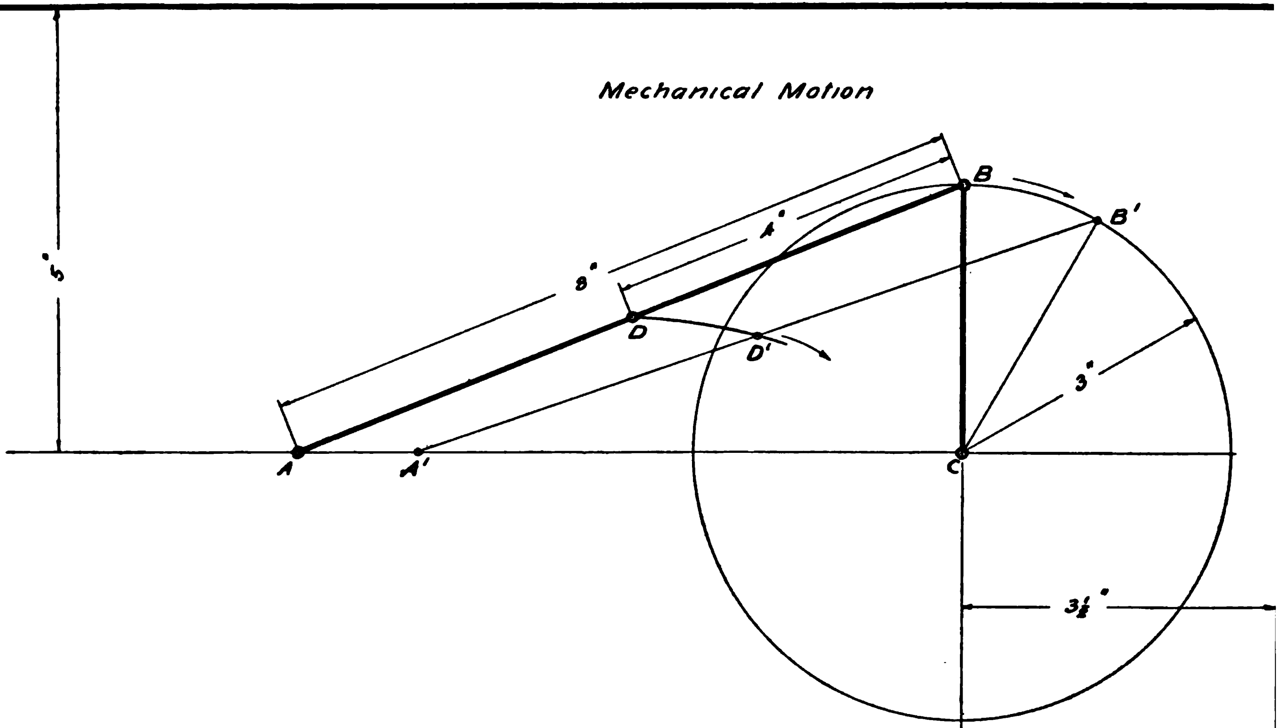
Note: Omit dimensions and construction lines, see following page.

## Practical Application of an Ellipse



*Note: If desired, give bridge a flat tint of light gray color*

## Mechanical Motion

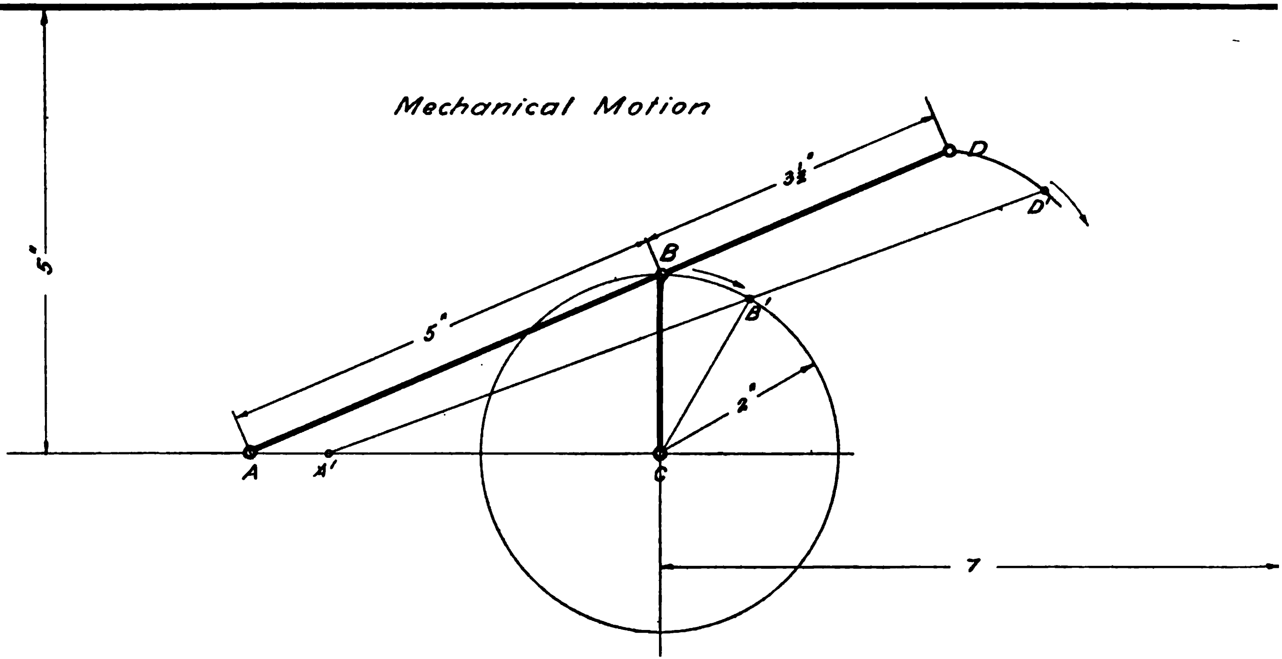


Path of motion of point D during one revolution around centre C
Point A moves right and left on a straight line.

Note: Omit dimensions, but provide construction in red lines

PLATE ☐

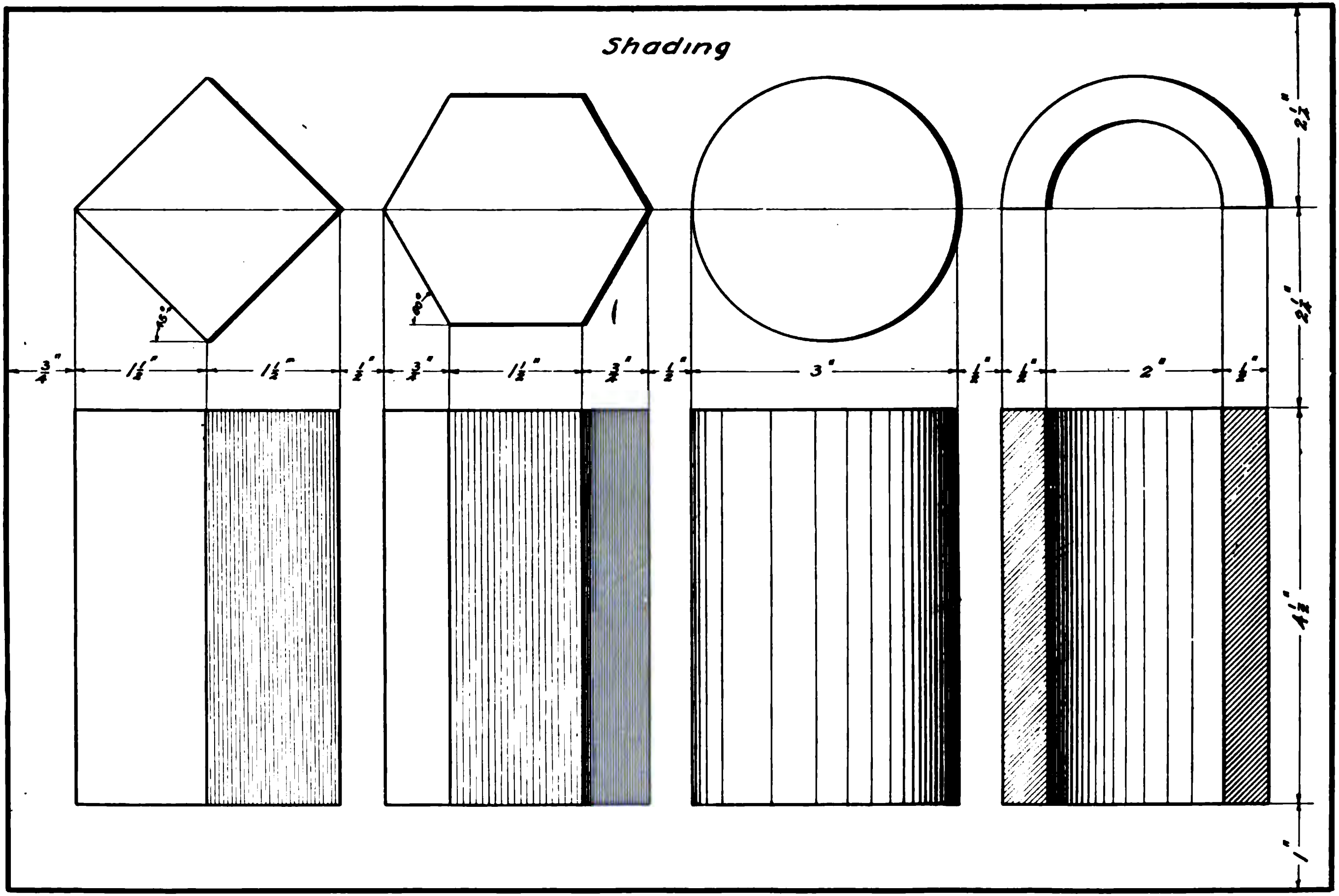
## Mechanical Motion



Path of motion of point D during one revolution of B around centre C.
Point A moves right and left on a straight line.

Note: Omit dimensions, but provide construction in fine red lines.

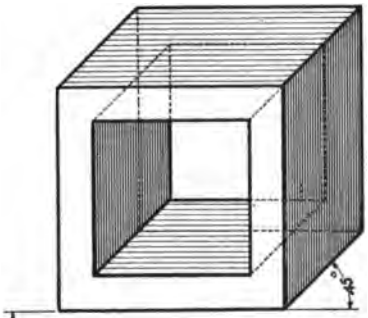
PLATE ☐



*Note. Omit dimensions Shading lines in black ink*

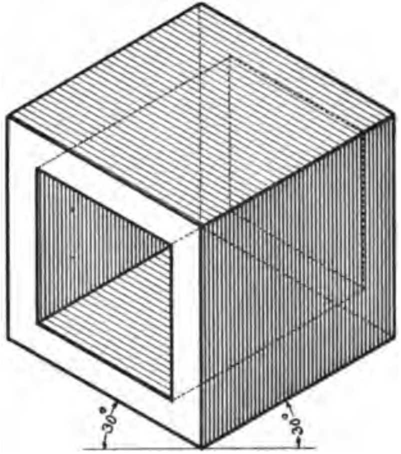
# Projections.

## Hollow Cube.
2" square, walls $\frac{3}{8}$" thick.



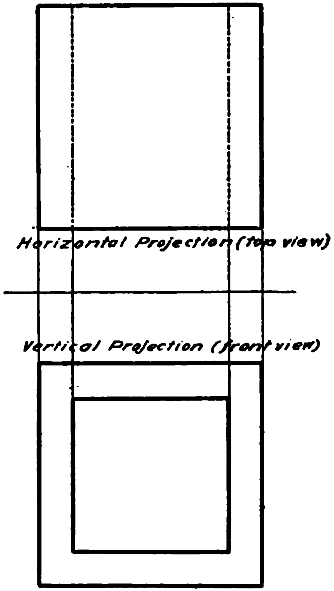
## Oblique Projection

On 2 of 3 "Axes"-horizontal and vertical-dimensions are measured full size, on the third axis - 45°- the dimensions are half size.



## Isometric Projection

On all three "Axes"-one vertical the other two at 30° to the horizontal line - all dimensions are measured full size.


Horizontal Projection (top view)
Vertical Projection (front view)

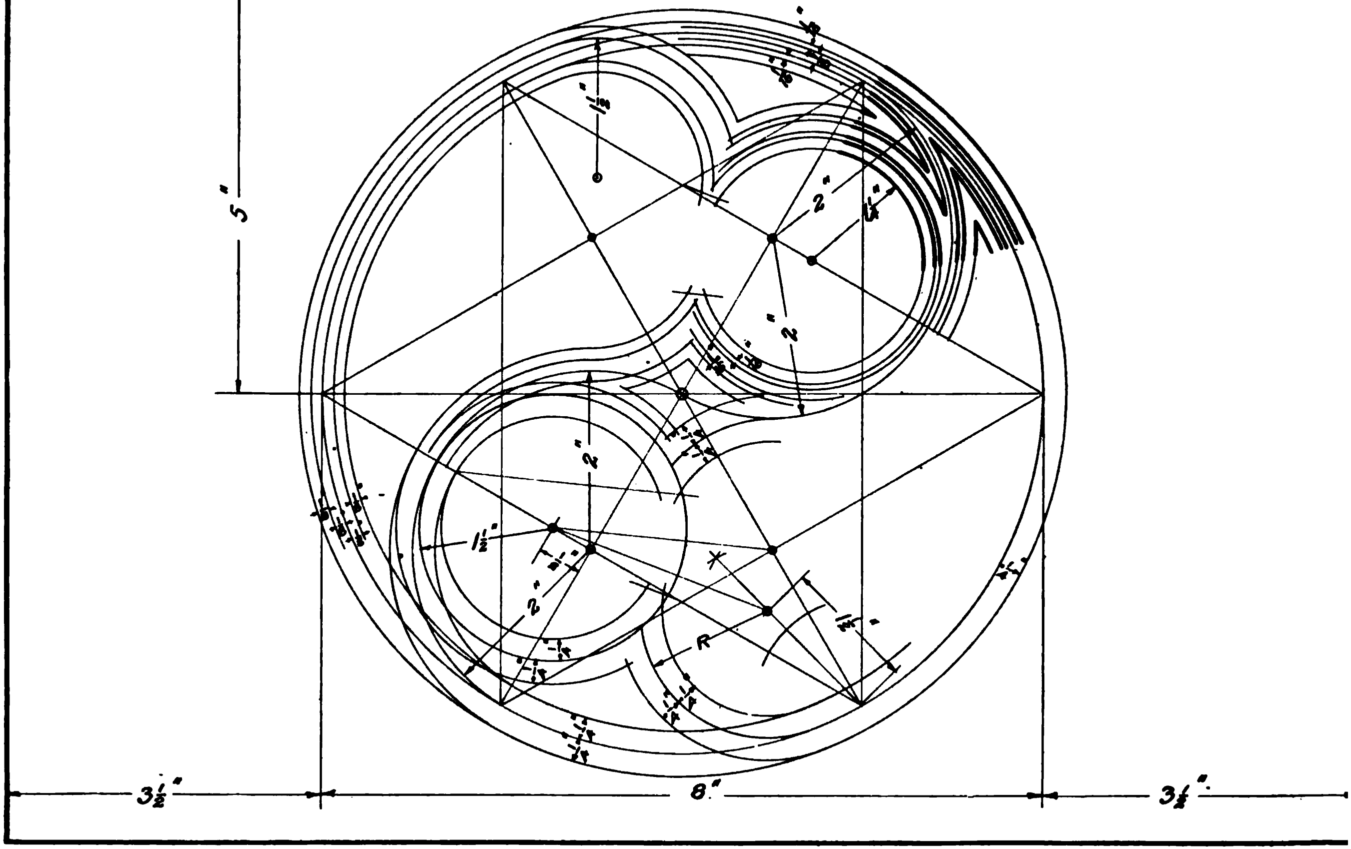
## Orthographic Projection

All "views" of the object are projected vertically from one into the other. Dimensions are measured full size.

4"

Note: Provide all explanatory printing.

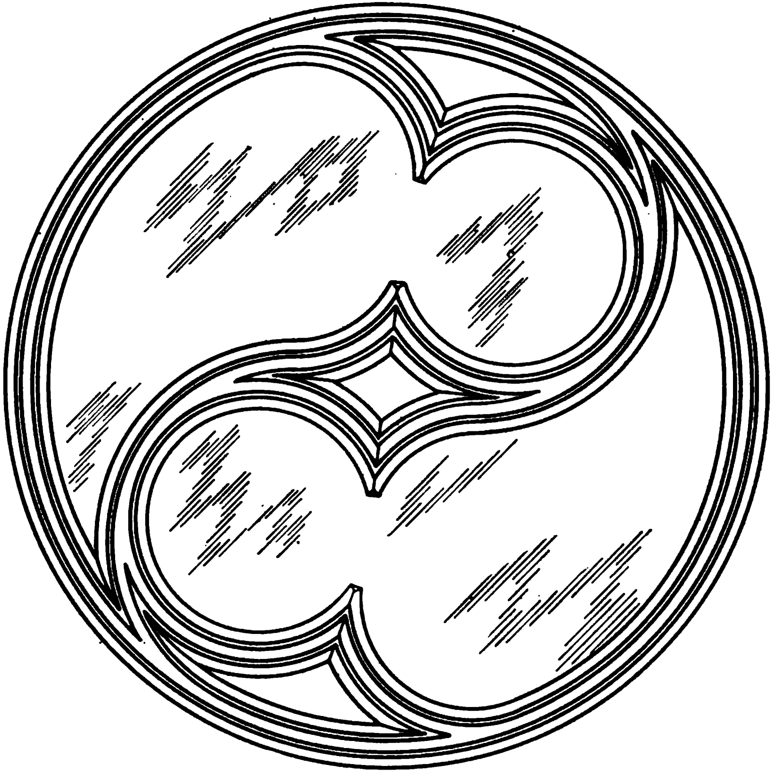
## Round Gothic Window. (construction)



Note: Omit dimensions and construction lines; see following page

PLATE ☐

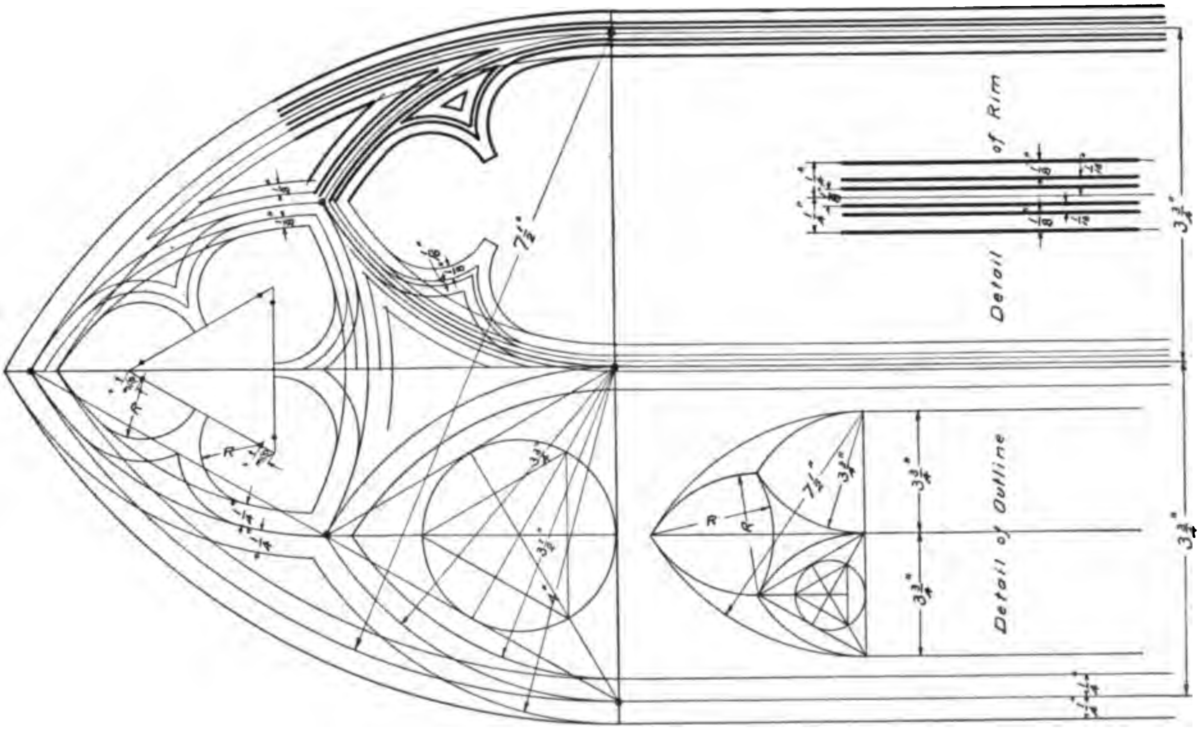
Round Gothic Window.



Note: If desired, tint glass part in light blue, wood in brown color.

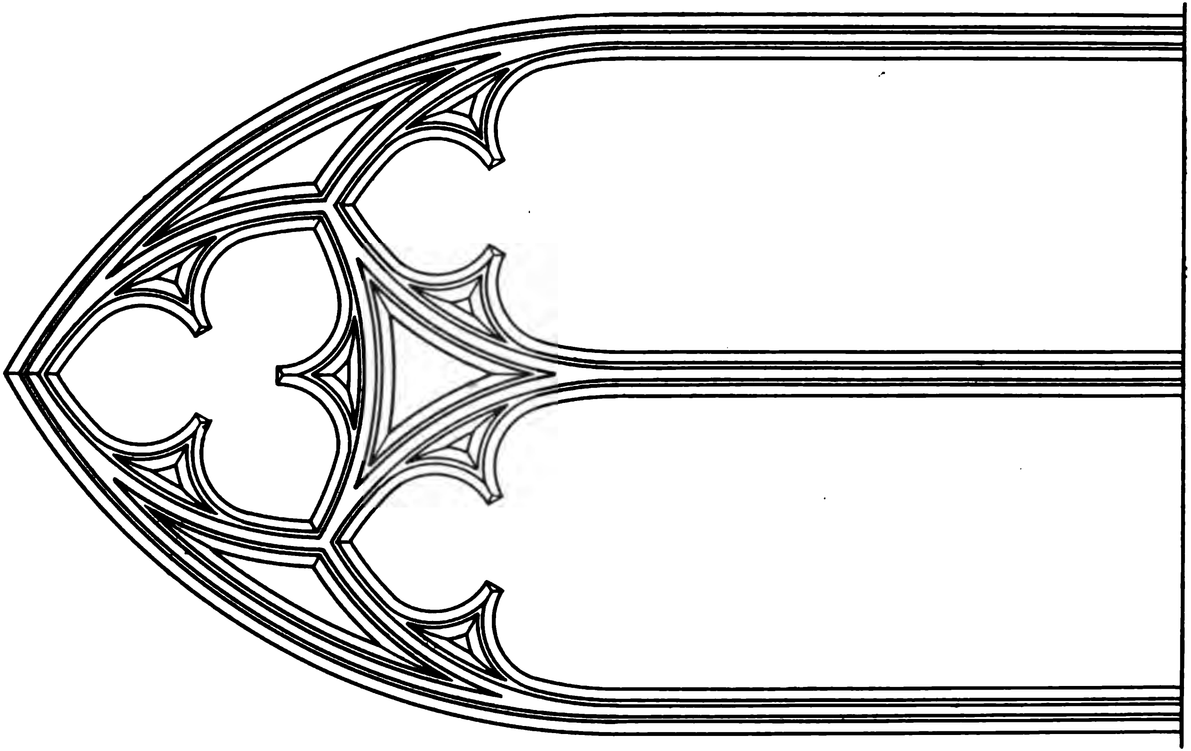
PLATE ☐

Long Gothic Window. (construction)



Note: Omit dimensions and construction lines, see following page.

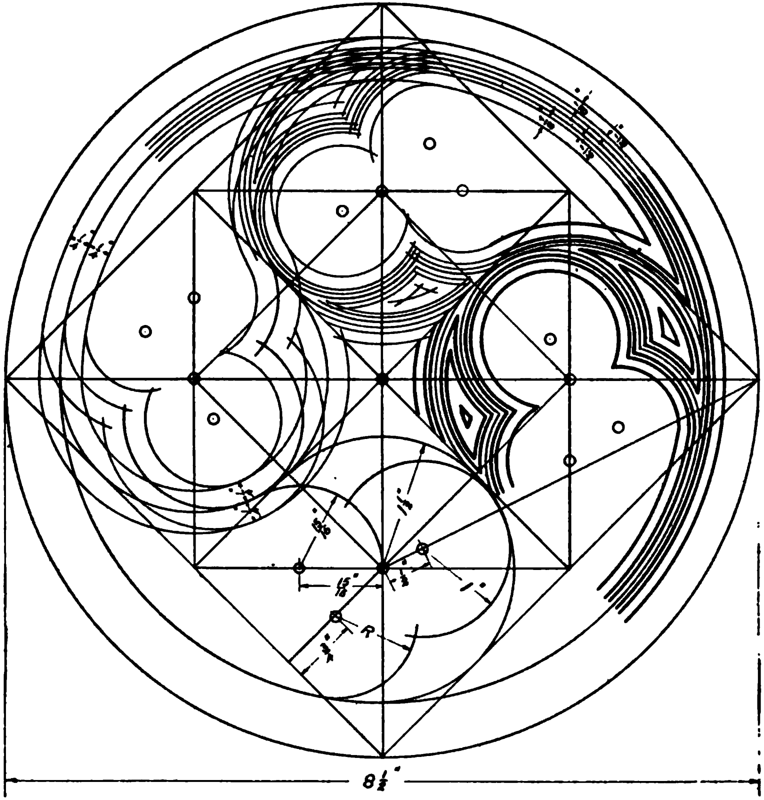
PLATE



Long Gothic Window.

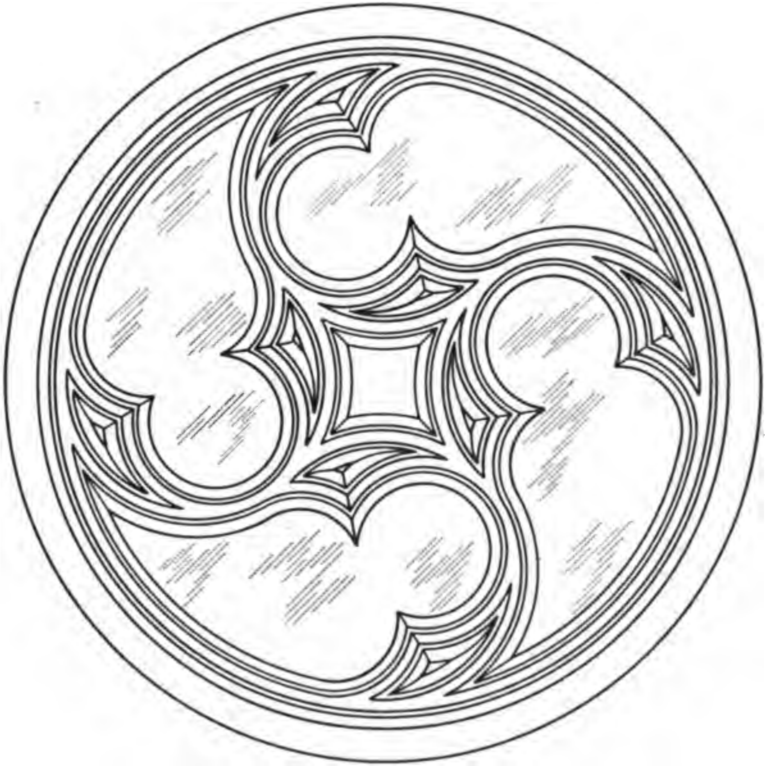
PLATE ☐

## Round Gothic Window: (construction)



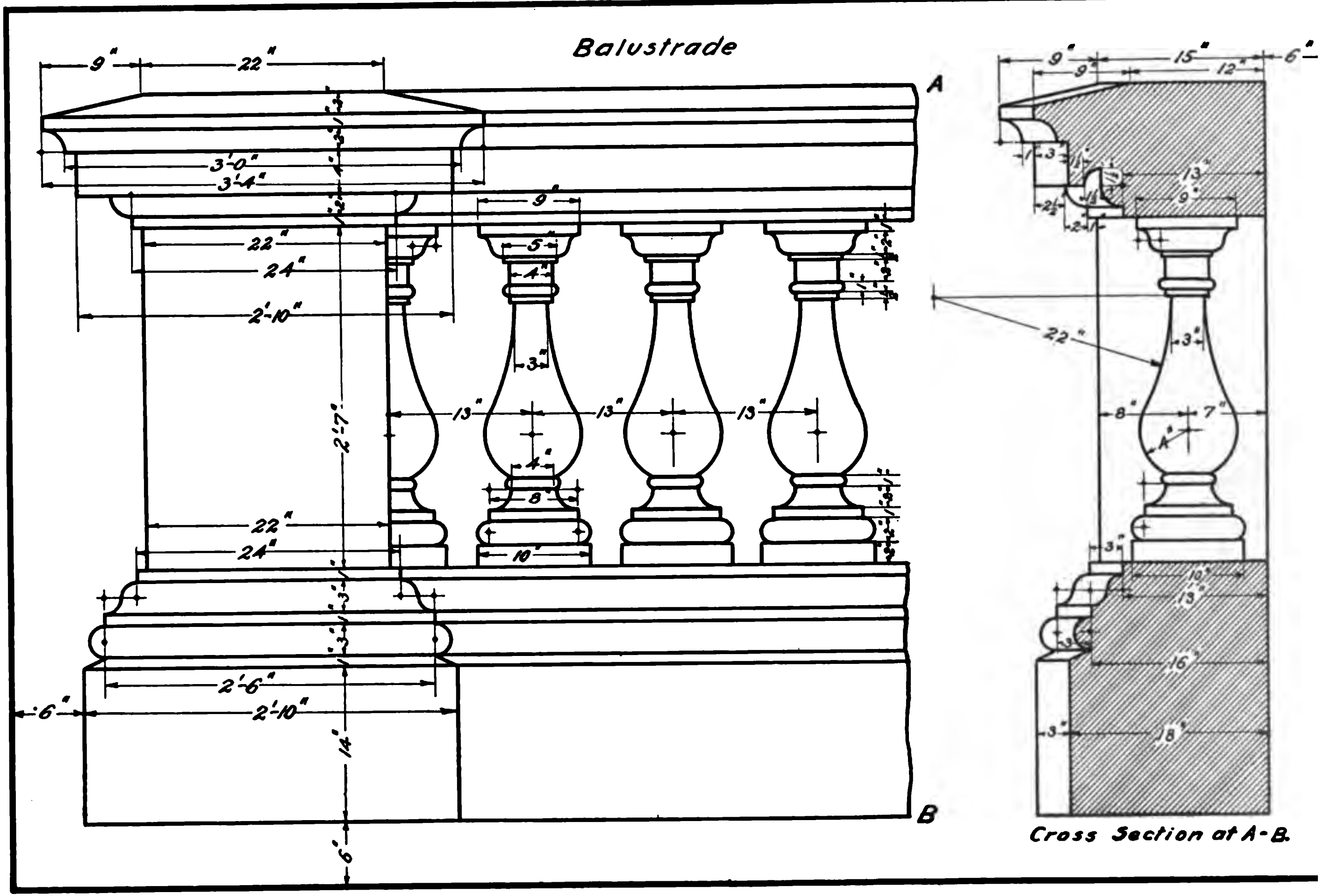
*Note: Omit dimensions and construction lines; see following page*

## Round Gothic Window.



*Note: If desired, tint glass part in light blue, wood in brown color.*

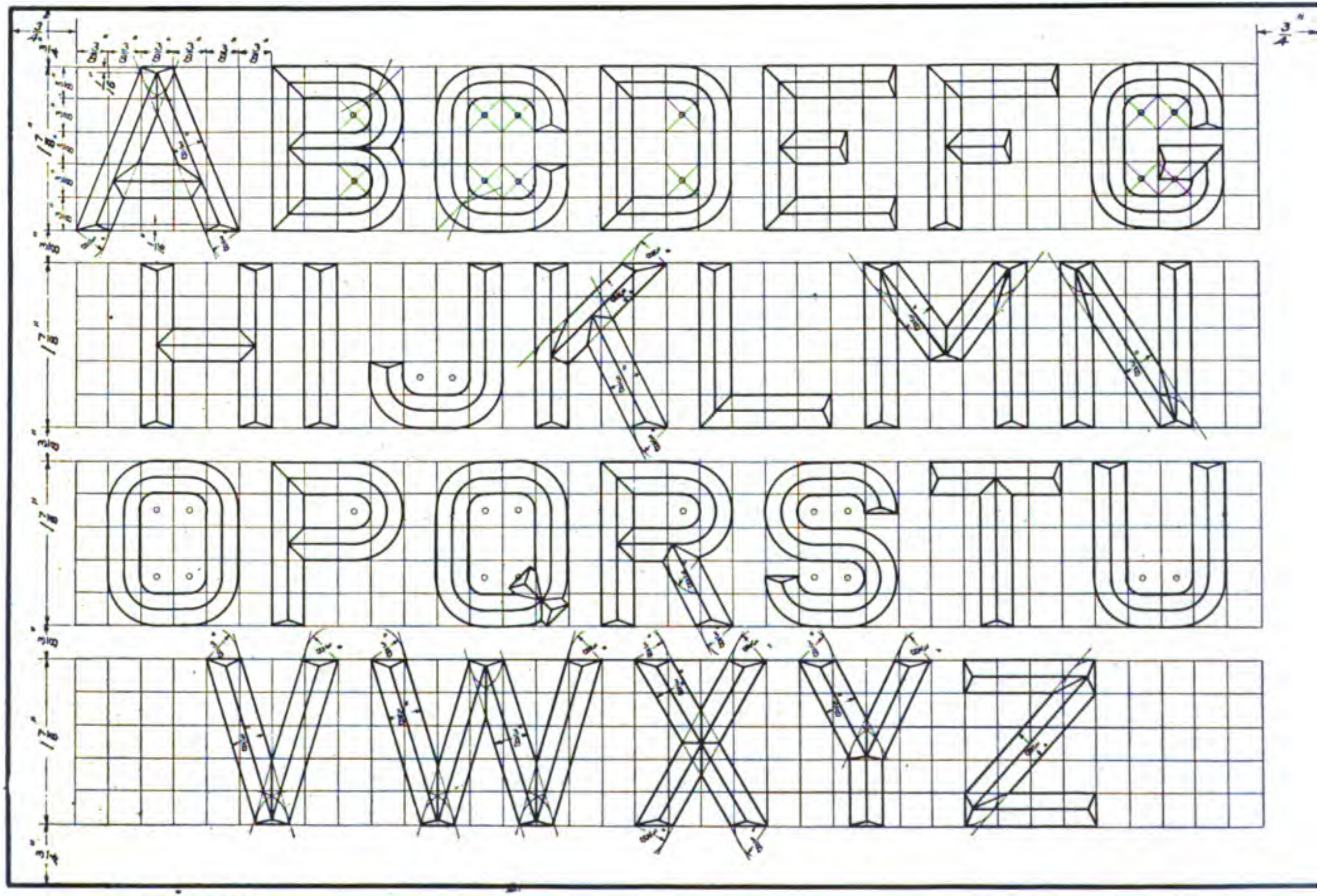
PLATE ☐



Cross Section at A-B.

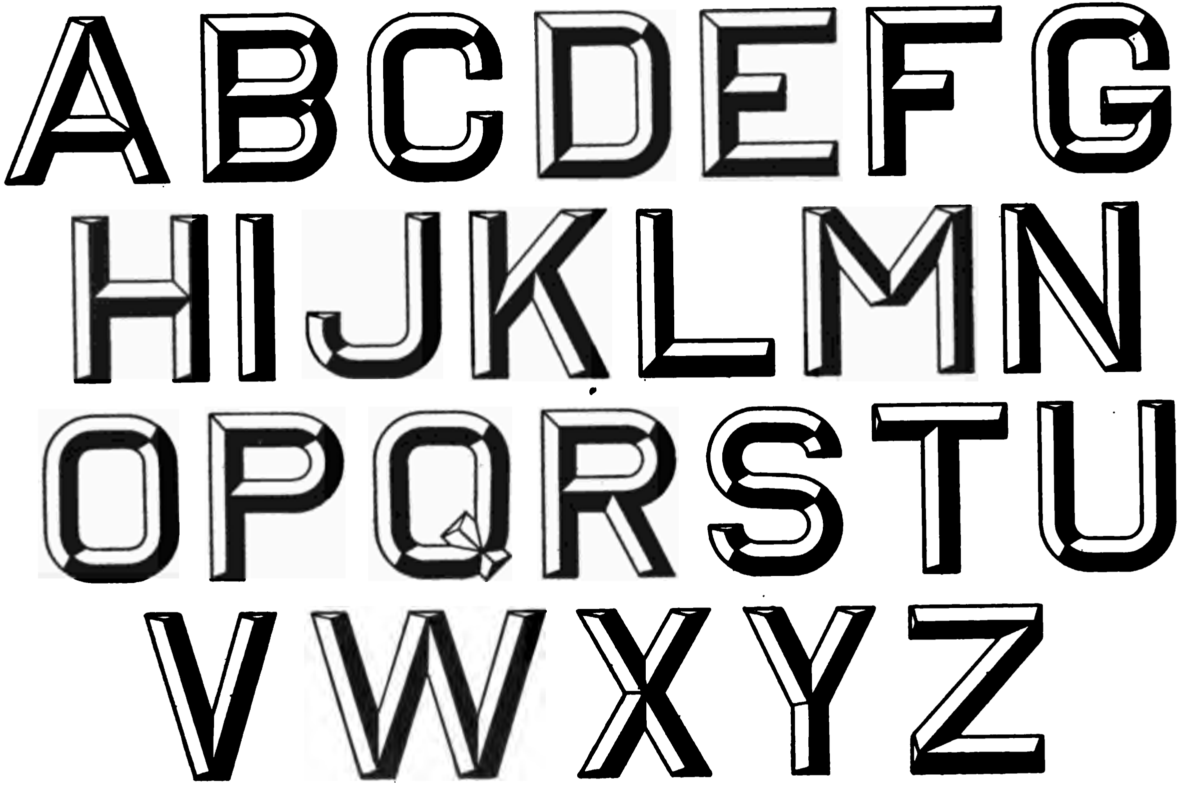
*Note: Omit dimensions; provide cross section lines as shown. Use scale: 1½" = 1 Foot.*

PLATE ☐



*Note: Omit dimensions and construction lines; see following page.*

PLATE ☐



*Note: If desired give letters a flat tint, the black part a darker tone*

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# Geometrical Data

## Polygon and Circle.

| Nº of Sides of Polygon | Given: Diam. of circumscr. Circle. | Given: Length of side of Polygon. | | Given: Diam. of Inscribed Circle |
|---|---|---|---|---|
| | Find: Side of Polygon | Find: Diam. of circumscr. Circle | Find: Area of Polygon | Find: Diam. of circumscr. Circle |
| 3 | 0.8660 | 1.1547 | 0.4330 | 2. |
| 4 | 0.7071 | 1.4142 | 1. | 1.4142 |
| 5 | 0.5878 | 1.7013 | 1.7205 | 1.2361 |
| 6 | 0.5000 | 2.0000 | 2 5981 | 1.1547 |
| 7 | 0.4381 | 2.3028 | 3.6339 | 1.1099 |
| 8 | 0.3827 | 2.6131 | 4.8284 | 1.0824 |
| 9 | 0.3420 | 2.9238 | 6.1818 | 1.0642 |
| 10 | 03090 | 3.2361 | 7.6942 | 1.0515 |
| 11 | 0.2818 | 3.5495 | 9.3656 | 1.0422 |
| 12 | 0.2588 | 3.8637 | 11 1962 | 1.0353 |
| 13 | 02393 | 4.1786 | 13.1858 | 1 0299 |
| 14 | 02225 | 4.4940 | 15.3345 | 1.0257 |
| 15 | 0.2079 | 4.8097 | 17.6424 | 1.0223 |
| 16 | 0.1951 | 5.1258 | 20.1094 | 1.0196 |
| 17 | 0.1838 | 5.4422 | 22.7355 | 1.0173 |
| 18 | 0.1736 | 5.7588 | 25.5208 | 1.0154 |
| 19 | 0.1646 | 6.0755 | 28.4652 | 1.0138 |
| 20 | 0 1564 | 6.3925 | 31.5688 | 1.0125 |

Multiply given Diameter with Figure opposite Nº of sides

Multiply given Length with Figure opposite Nº of sides.

Multiply square of given Length with Figure oppos. Nº of sides.

Multiply given Diameter with Figure opposite Nº of sides

## Circumference and Areas of Circles

To find Circumference multiply Diam. by 3.1416

To find Area multiply square of Diam. by .7854

## Table of Decimal Equivalents of $\frac{1}{8}"$, $\frac{1}{16}"$, $\frac{1}{32}"$ & $\frac{1}{64}"$.

| | | | |
|---|---|---|---|
| 8ths. | $\frac{15}{16}$ =.9375 | $\frac{31}{32}$ =.96875 | $\frac{31}{64}$ =.484375 |
| | 32nds. | 64ths | $\frac{33}{64}$ =.515625 |
| $\frac{1}{8}$ =.125 | | | $\frac{35}{64}$ =.546875 |
| $\frac{1}{4}$ =.25 | $\frac{1}{32}$ =.03125 | $\frac{1}{64}$ =.015625 | $\frac{37}{64}$ =.578125 |
| $\frac{3}{8}$ =.375 | $\frac{3}{32}$ =.09375 | $\frac{3}{64}$ =.046875 | $\frac{39}{64}$ =.609375 |
| $\frac{1}{2}$ =.50 | $\frac{5}{32}$ =.15625 | $\frac{5}{64}$ =.078125 | $\frac{41}{64}$ =.640625 |
| $\frac{5}{8}$ =.625 | $\frac{7}{32}$ =.21875 | $\frac{7}{64}$ =.109375 | $\frac{43}{64}$ =.671875 |
| $\frac{3}{4}$ =.75 | $\frac{9}{32}$ =.28125 | $\frac{9}{64}$ =.140625 | $\frac{45}{64}$ =.703125 |
| $\frac{7}{8}$ =.875 | $\frac{11}{32}$ =.34375 | $\frac{11}{64}$ =.171875 | $\frac{47}{64}$ =.734375 |
| 16ths. | $\frac{13}{32}$ =.40625 | $\frac{13}{64}$ =.203125 | $\frac{49}{64}$ =.765625 |
| | $\frac{15}{32}$ =.46875 | $\frac{15}{64}$ =.234375 | $\frac{51}{64}$ =.796875 |
| $\frac{1}{16}$ =.0625 | $\frac{17}{32}$ =.53125 | $\frac{17}{64}$ =.265625 | $\frac{53}{64}$ =.828125 |
| $\frac{3}{16}$ =.1875 | $\frac{19}{32}$ =.59375 | $\frac{19}{64}$ =.296875 | $\frac{55}{64}$ =.859375 |
| $\frac{5}{16}$ =.3125 | $\frac{21}{32}$ =.65625 | $\frac{21}{64}$ =.328125 | $\frac{57}{64}$ =.890625 |
| $\frac{7}{16}$ =.4375 | $\frac{23}{32}$ =.71875 | $\frac{23}{64}$ =.359375 | $\frac{59}{64}$ =.921875 |
| $\frac{9}{16}$ =.5625 | $\frac{25}{32}$ =.78125 | $\frac{25}{64}$ =.390625 | $\frac{61}{64}$ =.953125 |
| $\frac{11}{16}$ =.6875 | $\frac{27}{32}$ =.84375 | $\frac{27}{64}$ =.421875 | $\frac{63}{64}$ =.984375 |
| $\frac{13}{16}$ =.8125 | $\frac{29}{32}$ =.90625 | $\frac{29}{64}$ =.453125 | |

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